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(*Continued on Third Page of Cover.*)

CONTRIBUTIONS TO BIOLOGY
FROM
THE HOPKINS SEASIDE LABORATORY
OF THE
LELAND STANFORD JR. UNIVERSITY

XXIV

Description of Two New Genera of Fishes (Ereunias and Draciscus) from Japan

BY DAVID STARR JORDAN AND JOHN OTTERBEIN SNYDER

AND

Description of Three New Species of Fishes from Japan

BY DAVID STARR JORDAN AND EDWIN CHAPIN STARKS

[Reprinted from the Proceedings of the California Academy of Sciences
3d Ser., Zoology, Vol. II]

STANFORD UNIVERSITY, CALIFORNIA
1901

PREFATORY NOTE.

This memoir is the twenty-fourth of a series designed to illustrate investigations and explorations connected with the Hopkins Seaside Laboratory, an adjunct of the biological laboratories of the Leland Stanford Junior University. These investigations have been carried on by means of the assistance given by Timothy Hopkins, Esq., of Menlo Park, California. This memoir appears in the publications of the California Academy of Sciences, the present edition being a reprint.

OLIVER P. JENKINS,
CHARLES H. GILBERT,
Directors Hopkins Laboratory.

Date of publication, April 24, 1901.

NOTES ON CEROCOCCUS.

BY ROSE W. PATTERSON.

PLATES XXII–XXIV.

AMONG the most injurious insects found upon the oaks west of the Rocky Mountains are those scale insects belonging to the genus *Cerococcus*. But three species of this genus have thus far been observed and described: viz., *Cerococcus quercus* Comst.[1], *C. ehrhorni* Ckll.[2], and *C. corticis* Town.[3]

The published accounts of these interesting coccids are limited to brief descriptions of the adult females. In each species the female lives within a case formed of waxy secretion. She is apodous, has single-jointed antennæ bearing stiff spines, and the terminal segment of her abdomen is prolonged into two lobes. Spinnerets of two kinds, single and double, occur. The mentum is two-segmented. Practically nothing descriptive of the immature stages or of the general biology of the insects has been published. As two of the species are common on the oaks of California, I have had opportunity to observe something of the life-history of these two forms, and the following notes include the results of this study. This paper was prepared in the Entomological Laboratory of Stanford University, under the direction of Professor V. L. Kellogg.

Cerococcus ehrhorni *Ckll.*

PLATE XXII, FIGS. 1–9; PLATE XXIV, *A*.

This species was first found on the live-oaks in the vicinity of Mountain View, California by Mr. E. M. Ehrhorn, and was described by Professor T. D. A. Cockerell in

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[1] U. S. Agric. Report 1881–1882, pp. 213, 214.
[2] "Psyche," Vol. VII, 1895, p. 255.
[3] Journal N. Y. Entom. Soc., Vol. VI, 1898, p. 170.

May 4, 1901.

"Psyche".[1] It probably occurs in all the comparatively moist regions of California west of the inner Coast Range; but the limits of its distribution have not been ascertained. In the Santa Clara Valley, it is found in abundance on *Quercus agrifolia*, the live-oak, and has been observed on a few scattered white-oaks, also. The insects seem to prefer the more sheltered parts of the tree and are most plentiful on the under sides of the branches, although they are also found hidden in the cracks of the rough bark on the trunk. Those on the branches are usually covered with a white fungus[2], while on the trunk they are free from it. The scale secretes a thin pellicle of white waxy material, ellipsoidal in form. The insects themselves are bright crimson and may be seen through their semitransparent coverings, often lying in close proximity to each other.

First Stage (fig. 1).—The insects are viviparous and the young begin to appear about the last of January or the first of February. In the first stage, they are about .21 mm. long, elliptical in outline, and distinctly segmented. The tip of the abdomen bears two lobes, each terminating in a long filament and bearing a pair of spiny hairs on its inner margin. The anal opening is between these lobes and is surrounded by four spines. Legs are present, and the tarsi are each furnished with four knobbed digitules (fig. 2). In these respects, the insect resembles *Dactylopius*. The antennæ (fig. 3) are composed of five segments including the basal joint, the first four being about equal in length, and the last twice as long as one of the others. There are two longitudinal rows of double pits on the dorsal surface of the abdomen, a pair in each segment about as far apart as they are distant from the lateral margins of the body. The insect is very active during this stage.

Second Stage (fig. 4).—With the first moult, important changes take place in the insect. Its legs disappear, and it begins to form its waxy case. Its many-jointed antennæ

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[1] June, 1895.

[2] This white fungus completely covers and protects the enclosed scales, and undoubtedly lives in a sort of symbiotic relation with the insect. The fungus derives food (honey dew) from the scale, while the scale gains an effective protective covering.

are replaced by minute non-segmented ones scarcely longer than wide and truncate at the tip; spines take the place of the long caudal filaments. Spiracles also appear; and the double pits are increased in number and scattered irregularly over the surface of the body. The insect has increased in length from .21 mm. to .354 mm., and the segments of its body are less distinct than in the first stage.

Adult Female. — Although there may be changes in structure between the second and the last stages, they have not been observed. The adult female (fig. 5) is from .75 to 1. mm. in length, regular in outline, and balloon-shaped. The terminal segment of the body is the only one that is plainly distinguished from the others. It is strongly chitinized and ends in two prominent points or lobes. Each lobe has a stout spine near its tip and bears several short ones on its inner margin. Both dorsal and ventral surfaces of the insect are covered with irregularly arranged pits, single and double. The latter, which have hairs growing from them, are not so numerous as the former. The antennæ (fig. 6) are small, unsegmented, and truncate at the tip. I have found only four comparatively long bristles and several short ones, although it has been stated by one author in a previous account that there are five. On the ventral side of the insect are two pairs of large spiracles (fig. 7), near each of which is a group of spinnerets, varying in number from two or three in the second stage to from eight to twelve in the adult.

Cerococcus quercus *Comst.*

PLATE XXII, FIGS. 10–15; PLATE XXIII, FIGS. 16–22; PLATE XXIV, *B.*

Cerococcus quercus is a large Coccid abundant on the oaks of Arizona and southern California. According to Professor Comstock, it is found on *Quercus oblongifolia*, *Q. undulata*, var. *wrightii*, and probably on *Q. agrifolia*.[1] The insects secrete thick coverings of bright yellow wax and are thus very noticeable on the tree, especially when they are massed together, as is usually the case. Dr. Howard, who became interested in the wax produced by this insect, had it analyzed and expressed the opinion, as Professor Comstock had done before, that the product might be of practical value, the supply being very great.[1]

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[1] U. S. Agric. Report 1881–1882, p. 213.

First Stage.—In the laboratory, the young insects (fig. 10) began to hatch in February and continued to do so until the middle of May, emerging through the opening in the posterior end of the waxen case of the mother. As food was not at hand, they ran about in a lively way; but when placed upon the tree, selected a suitable spot and inserted the beak. From this time on they appeared to be inactive, and it was found that they had begun to secrete their coverings. The wax seemed to come from the double pits and stood out from the body of the insect in transparent rods, giving it a spiny appearance. In the first stage, the insect is about .5 mm. long, elliptical in outline, and distinctly segmented. The caudal segment (fig. 11) terminates in two prominent lobes with long filaments, as in *C. ehrhorni*, and bears at least four pairs of comparatively short spines. Eight spines surround the anal opening. The legs of this species (fig. 12) are long compared with those of *C. ehrhorni*, and the tarsi each bear four knobbed digitules. The antennæ (fig. 13) are six-jointed, counting the basal segment, the third being about as long as the first and second combined, the rest approximately equal in length. The dorsal surface of the body has large double pits arranged in six longitudinal rows about equidistant from each other; no single pits occur.

Intermediate Stage.—As the second stage of the insect is not to be found in the material at hand, it is necessary to pass to a later stage. Here the insect (fig. 14) is subovate, about 1.4 mm. long, and the abdomen is distinctly segmented. The long filaments at the end of the body have disappeared and short spines take their place. In the

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[1] U. S. Dept. Agric., Div. Ent., Bull. 9, New Series, p. 39.

original description, it was incorrectly stated that the insect has no antennæ. These organs (fig. 16) are minute and unsegmented, irregularly cone-shaped and truncate at the tip, bearing several long stiff bristles and a number of short ones. In this stage the insect has remarkably large tracheal tubes which may be seen plainly when the specimen has been boiled in K O H. The spiracles, also, are easily seen. Double pits connected with large glands are scattered irregularly over the dorsal surface of the body, and single pits are very numerous in certain regions. Large groups of the latter extend from the margin of the body to each of the spiracles, and in each of the five segments next to the last a distinct band of single pits extends across the body. The last segment has a small group near the base of each terminal lobe.

The sac of the insect (fig. 17) at this stage is not so convex as that of the adult and is somewhat like an air-cushion in form. The larval skin, which is orange-colored, is imbedded in the wax at the center of the dorsal surface; and the secretion forms two rings about it. Slightly dorsad of the posterior end of the case is a tubercle in which is an opening.

Adult Female.—The adult female is elliptical in outline and more or less distinctly segmented. The terminal segment is not strongly chitinized, and the caudal lobes, which are not so prominent as those of *C. ehrhorni*, each bear a long bristle and several short ones. Double pits in large numbers are scattered over the surface of the body, but single pits do not appear to be numerous as in the intermediate stage just described. The antennæ are similar to those of the preceding stage (fig. 16). The sac of the fully developed female (fig. 18) is about 6 mm. long and 5 mm. wide. It is irregularly elliptical in outline, very convex above, and somewhat flattened below. The larval skin is slightly cephalad of the center of the dorsal surface, and along the lateral margins are a number of little projections, probably corresponding to the segments of the body. The wax forms a smooth sheet, as if the filaments which compose it had melted and run together. When the eggs are laid, the body of the female shrinks away and is pushed to one side, the space within the waxen case being closely packed with eggs.

Male.—One specimen, only, of the male (fig. 19) was obtained. It was found within its cocoon (fig. 20) in some material that had been killed with cyanide and was imperfect. From the cephalic to the caudal extremity, the insect measures about 1.3 mm. The head, thorax and abdomen, though closely connected, are easily distinguished. The head, which appears to be nearly globular in form, is pointed in front. One pair of large eyes was observed on the dorsal side in close proximity to the bases of the antennæ. Though others may occur, they were not distinguished. The antennæ are ten-jointed and are attached to the dorsal surface of the head very near its cephalic extremity. The first joint is short and about as wide as it is long, the second is large and club-shaped, the third is the longest, and the remaining joints are about equal in length, each being about two-thirds the length of the third joint. The antennæ are covered rather densely with hairs, and the last joint bears two pair of knobbed digitules attached near its tip.

The thorax is large, subquadrate in form, with rounded angles, and nearly as wide as it is long. The wings, which are attached to the lateral margins of the thorax, are thin and delicate and more or less evenly covered with short hairs. Balancers were not observed. The legs (fig. 21) are more slender than those of the female and covered, not very densely, with hairs. They resemble each other in form, and the tarsi each bear four knobbed digitules.

The abdomen is slightly wider than the thorax and about twice the length of the latter. It is composed of nine segments, the first of which is wider than the others. Those from the second to the eighth inclusive are similar in form, but increase in size to the fourth, then decrease. The ninth (fig. 22) is modified in form, and from it projects the penis.

Cerococcus corticis *Town.*

PLATE XXIII, FIGS. 23-28.

Cerococcus corticis was discovered by Mr. Koebele, in 1897, on *Quercus engelmanni*, in Nogales, Sonora. It is between the two species described above in size and shape, but resembles the former in being bright crimson and in having conspicuous spiracles. A black fungus follows this scale, rendering it less noticeable than it would otherwise be. The covering of the insect is of white wax and is not smooth on the surface, but is covered with fine filaments which give it a cottony appearance. But two stages in the development of this species were observed—the first stage and the adult female.

First Stage.—Like *C. ehrhorni*, these insects are viviparous. The young (fig. 23) are similar to those of the two species described above, being elliptical in outline, distinctly segmented, and having two caudal lobes. The latter, however, bear stiff hairs (fig. 24) instead of long filaments. As with *C. quercus*, the legs (fig. 25) are long, and each is furnished with four knobbed digitules. The antennæ (fig. 26) are six-jointed like those of the last named species, but are different from them in form. The first, second, fourth, and fifth joints are nearly equal in length, the third is slightly longer than the first, and the last about twice as long as the first.

Adult Female.—The adult female (fig. 27) is similar in outline to the intermediate stage of *C. quercus*. The terminal segment of the body, though strongly chitinized, is not so prominent as that of *C. ehrhorni*. The antennæ (fig. 28) are very small, unsegmented, about as broad as long, and truncate at the tip, with eight bristles.

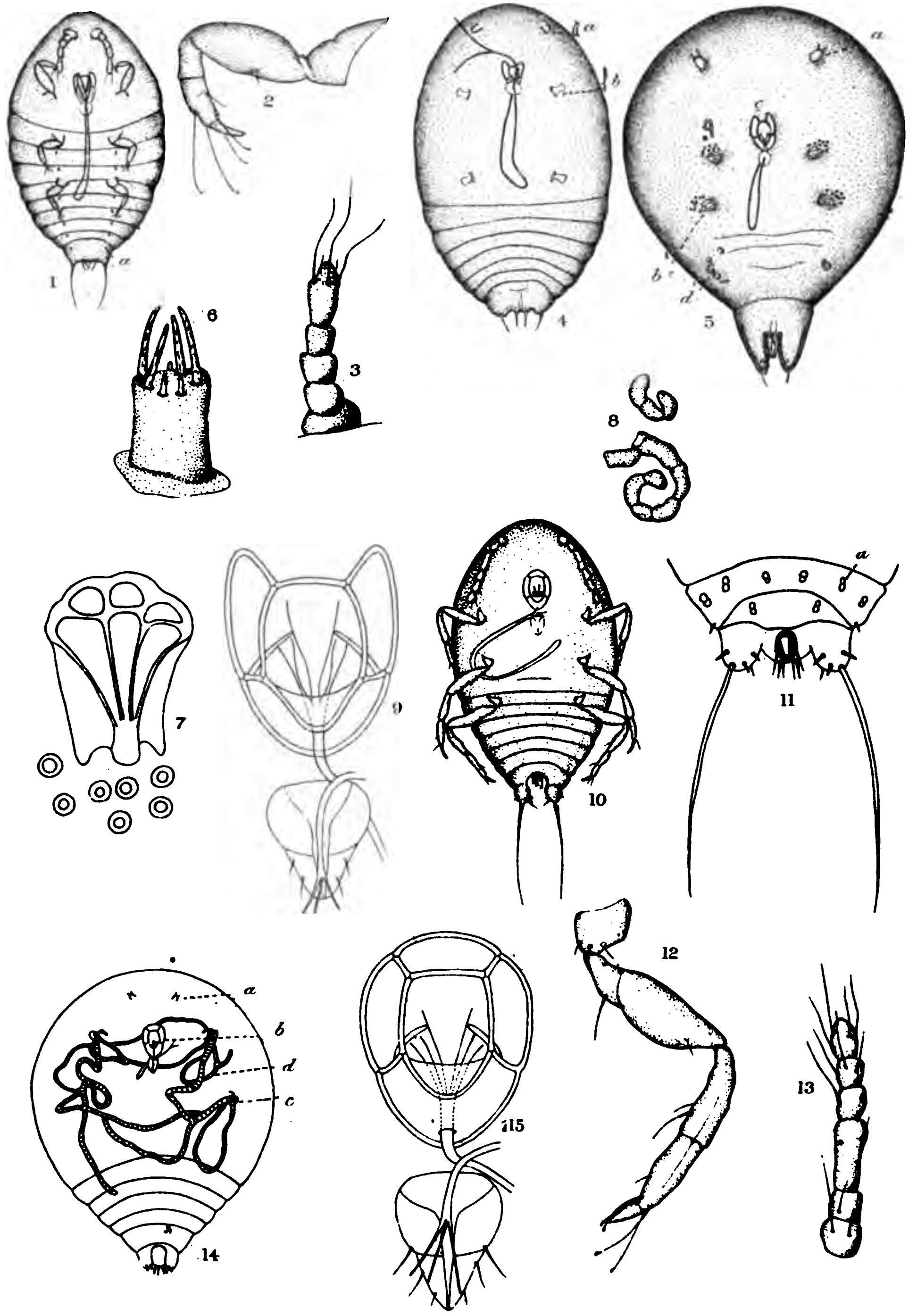
EXPLANATION OF PLATE XXII.

Cerococcus ehrhorni CKLL.

Fig. 1. First larval stage of female; *a*, double pits.
Fig. 2. Leg of first larval stage of female.
Fig. 3. Antenna of first larval stage of female.
Fig. 4. Second stage of female; *a*, antenna; *b*, spiracle.
Fig. 5. Adult female; *a*, antenna; *b*, spiracle; *c*, mouth-parts; *d*, fungus filaments.
Fig. 6. Antenna of adult female.
Fig. 7. Spiracle of adult female.
Fig. 8. Fungus filaments.
Fig. 9. Mouth-parts of adult female.

Cerococcus quercus COMST.

Fig. 10. First larval stage of female.
Fig. 11. Caudal segment of first larval stage of female; *a*, double pits.
Fig. 12. Leg of first larval stage of female.
Fig. 13. Antenna of first larval stage of female.
Fig. 14. Intermediate stage of female; *a*, antenna; *b*, mouth-parts; *c*, spiracle; *d*, tracheal tube.
Fig. 15. Mouth-parts of intermediate stage of female.



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FIG'S. 1-9. CEROCOCCUS EHRHORNI *CKLL.*
FIG'S. 10-15. CEROCOCCUS QUERCUS *COMST.*

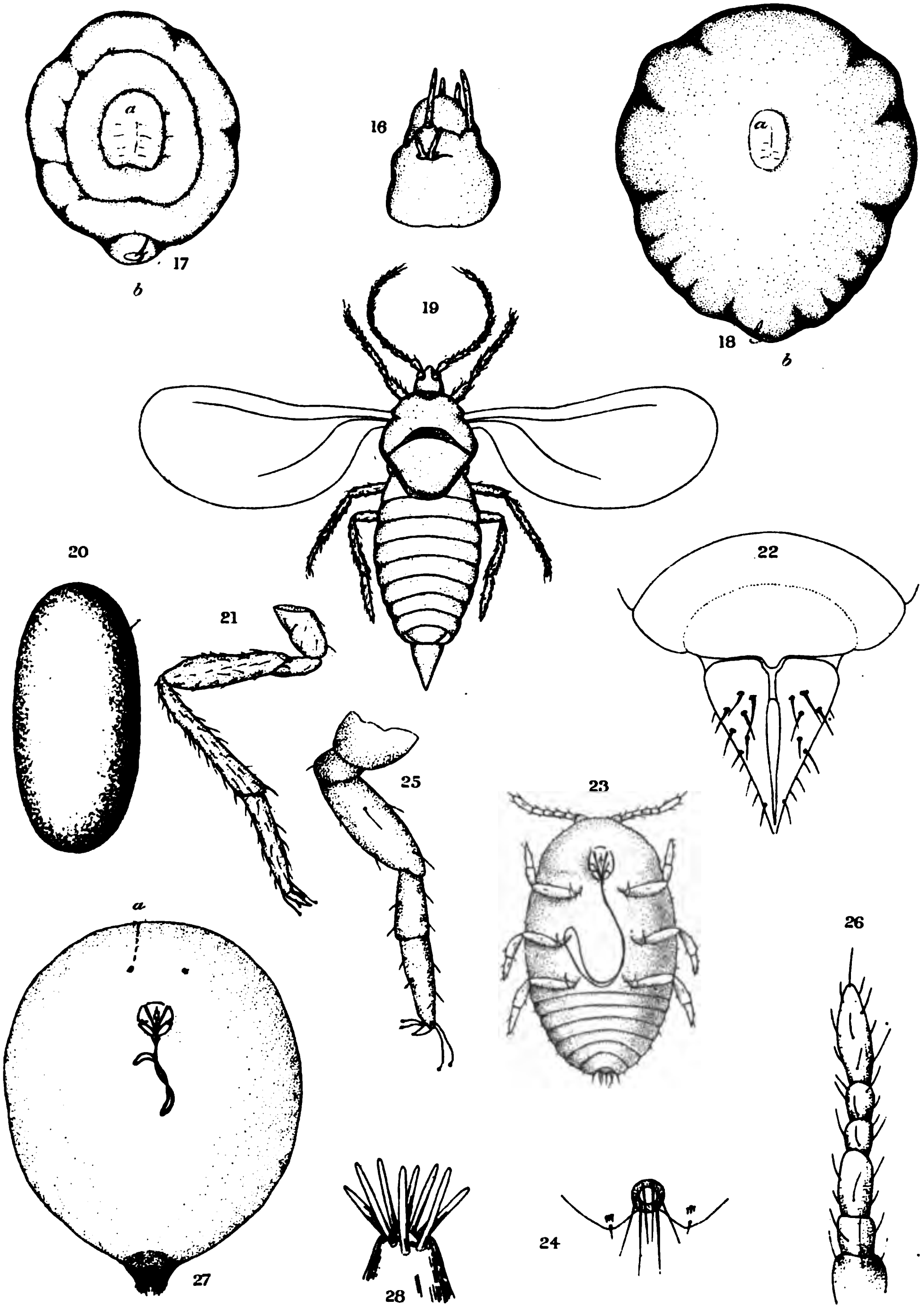
EXPLANATION OF PLATE XXIII.

Cerococcus quercus COMST.

Fig. 16. Antenna of intermediate stage of female.
Fig. 17. Sac of intermediate stage of female; *a*, larval skin; *b*, opening in tubercle.
Fig. 18. Sac of adult female; *a*, larval skin; *b*, opening in tubercle.
Fig. 19. Adult male.
Fig. 20. Cocoon of male.
Fig. 21. Leg of adult male.
Fig. 22. Last abdominal segment of adult male.

Cerococcus corticis TOWN.

Fig. 23. First larval stage of female.
Fig. 24. Tip of abdomen of first larval stage of female.
Fig. 25. Leg of first larval stage of female.
Fig. 26. Antenna of first larval stage of female.
Fig. 27. Adult female; *a*, antenna.
Fig. 28. Antenna of adult female.



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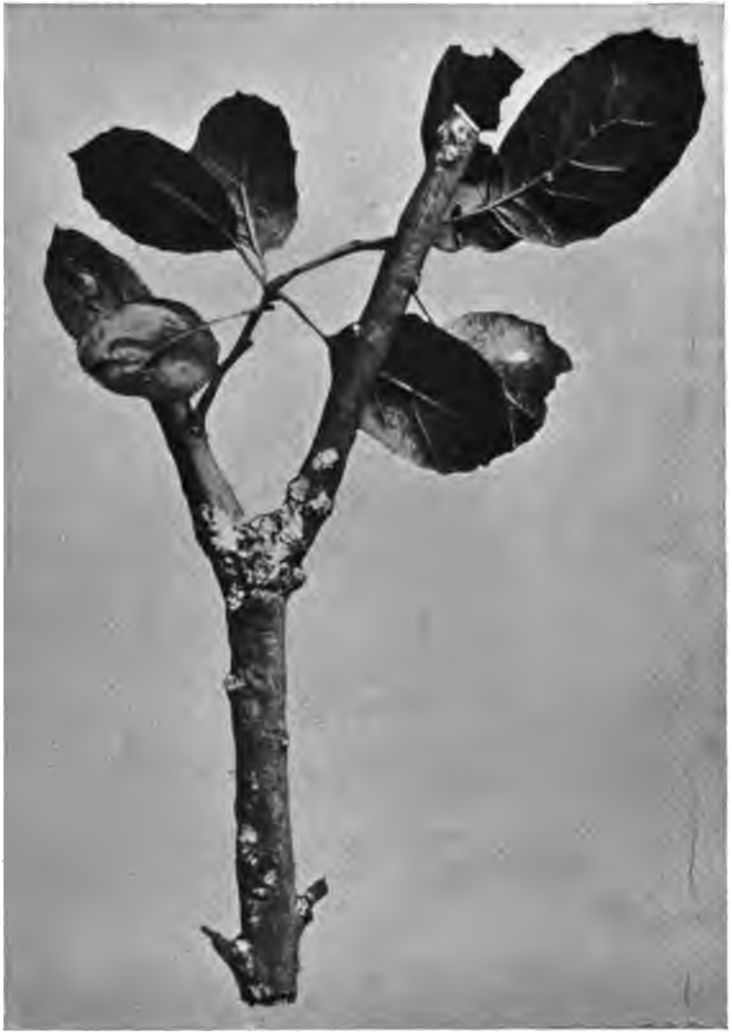
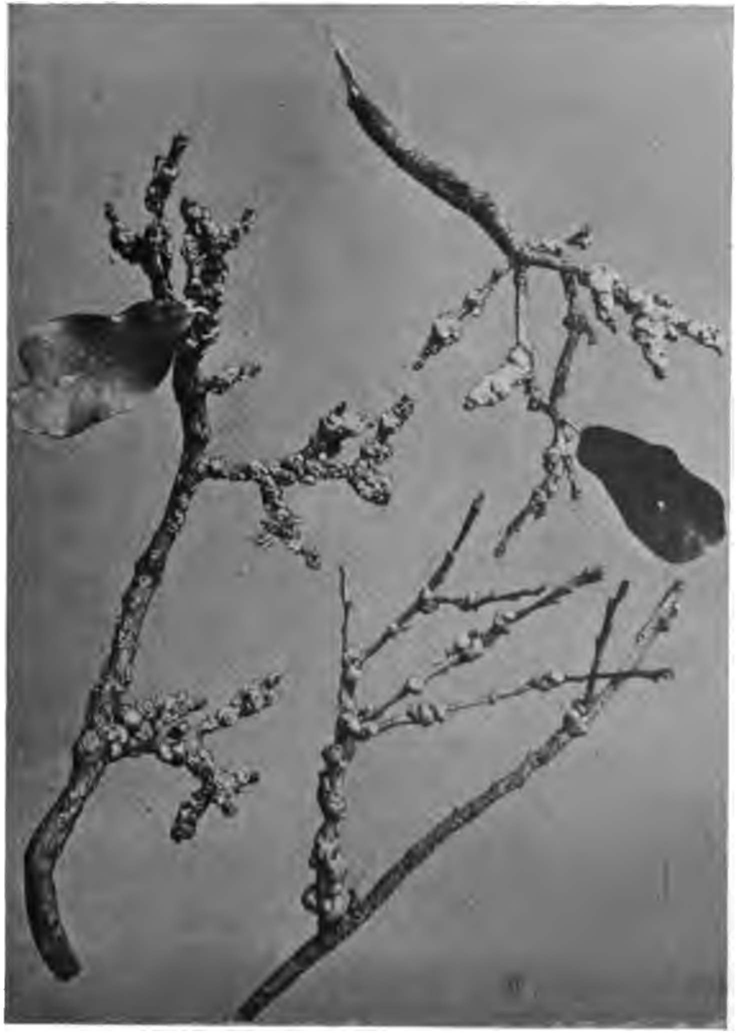
FIG'S. 15-22 CEROCOCCUS QUERCUS *Comst.*
FIG'S. 23-28. CEROCOCCUS CORTICIS *Town.*

EXPLANATION OF PLATE XXIV.

A. *Cerococcus ehrhorni* CKLL., from photograph.
B. *Cerococcus quercus* COMST., from photograph.



A. Cerococcus ehrhorni *Ckll.*



B. Cerococcus quercus *Comst.*

NOTES ON NEW AND LITTLE KNOWN CALIFORNIAN COCCIDÆ.

BY S. I. KUWANA.

PLATES XXV AND XXVI.

INTRODUCTION.

THE present paper is made up of descriptions of three new species of Coccidæ, or scale insects, from California, with some notes on a little known form. The writer's thanks are due Professor T. D. A. Cockerell, for his courtesy in examining specimens, and for his assistance in their determination.

This paper was prepared in the Entomological Laboratory of Stanford University, under the direction of Professor V. L. Kellogg.

DESCRIPTION OF NEW SPECIES.

Eriococcus artemisiæ, sp. nov.

PLATE XXV, FIGS. 1–10.

Adult Female.—Enclosed in a broad oval sac about 3 to 5 mm. long and 2 to 3 mm. broad; snow-white, more or less woolly, and uniform in texture. (The sacs vary more or less in shape and size; some are somewhat pointed at one end, while others are perfectly round, etc.)

Body oval in form, very plump, 4 mm. long, 2.5 mm. wide; color black, legs and antennæ pale brown. Antennæ seven-segmented, each segment with a few spiny hairs; seventh segment longest, other segments variable. I have observed the following variations in lengths of segments:

7 (6, 2, 3, 1) 4, 5 }
7, 3 (2, 6) 4, 5, 1 } one specimen.

7 (2, 4) 1, 6 (5, 3) }
7 (6, 4, 2) (1, 3, 5) } one specimen.

(6, 3) 1, 2, 5, 4 }
7 (1, 3) 6, 2 (4, 5) } one specimen.

May 20, 1901.

Legs, comparatively small; coxa very stout, very much wider than long; trochanter of the usual triangular shape; femur very much narrower than the coxa and longer than tarsus; tibia about two-thirds as long as the tarsus; claw stout and curved; both tarsus and claw with long filiform digitules. Dorsal surface with prominent capitate spines; ventral, with spiny hairs. Anal ring large, with six long hairs; posterior extremity with a single long bristle on each side of the anal ring.

Adult Male.—Wing expanse about 2 mm.; length of body 1.2 mm.; color reddish purple; antennæ and legs yellowish brown, eyes dark purple, wings slightly dusky. Body long and slender. Head rather small, wider than long. Three pairs of eyes, one pair on each dorsal and ventral surface, the third pair, which are small and transparent, on the side. Antennæ nine-segmented, each segment with many spiny hairs; first and second segments stoutest, third longest, the rest subequal, ninth segment with six long knobbed hairs. Prothorax very small, mesothorax largest, metathorax as wide as mesothorax but very much shorter. Legs slender and more or less hairy; only two tarsal digitules are to be seen. (If there are any on the claw they could not be found.) On each side of eighth abdominal segment are three long hairs supporting a long white waxy filament.

Larva.—A full grown male larva taken out from the cocoon is elliptical in form, and slightly reddish black in color; antennæ and legs, yellowish brown, about 2 mm. long and 1 mm. wide. Antennæ six-segmented, stout, each segment with a few spiny hairs; sixth segment longest, third next to the longest,—formula 6, 3, 2, 1 (4, 5). Legs stout; tarsus and tibia almost equal in length. No capitate hairs on dorsal aspect.

Egg.—Broadly elliptical, .38 mm. long, .3 mm. wide, purple in color, and smooth.

Habitat.—Found on sage-brush (*Artemisia* sp.), in the foot-hills of the Sierra Morena, Stanford University. Collected by the author March 24, 1900.

Cocoons of male and female sacs are found at the base on the trunks of the shrubs, where they are covered by decaying leaves or sheltered by other substances. The specimens first collected were all males, but several weeks later the female sacs were also found. The adult males came out about the middle of April, in the laboratory; they were badly infested by the larvæ of a species of ladybird. While trying to rear adult males and eggs from male cocoons and egg-sacs, my specimens were all devoured by these coccinellid larvæ.

Ripersia festucæ, sp. nov.

PLATE XXV, FIGS. 11–16.

Adult Female.—Elongate-elliptical in form, covered with white powder; sac suboval or round, about 2 mm. long, loosely woven, composed of long white wool.

Body about 3 mm. long and one-third as wide as long, with short spiny hairs on dorsal surface. (After being boiled in hot water in order to take the waxy substance off, the color was darkish purple; legs and antennæ pale brown.) Antennæ seven-segmented,[1] each segment with a few spiny scattered hairs; seventh segment usually longest, second next in length, fourth, fifth, and sixth usually subequal. There is quite a variation in the segments even in the same insects, as shown in the following formulæ:—

$$\left.\begin{array}{l} 7,\ 2,\ 1,\ 4\ (5,\ 6)\ 3 \\ 7,\ 2,\ 1,\ 6\ (3,\ 4)\ 5 \end{array}\right\}\ \text{one specimen.}$$

$$\left.\begin{array}{l} 7,\ 2,\ 1,\ 3\ (4,\ 5,\ 6) \\ 7\ (1,\ 2,\ 3)\ 6\ (4,\ 5) \end{array}\right\}\ \text{one specimen.}$$

$$\left.\begin{array}{l} 7,\ 2\ (1,\ 4)\ (3,\ 6)\ 5 \\ 7,\ (1,\ 2,\ 4)\ (3,\ 5,\ 6) \end{array}\right\}\ \text{one specimen.}$$

Legs large and well developed; coxa stout, almost as wide as long; trochanter triangular in form; femur very long, .16 mm. long, .05 mm. wide; tibia smaller than femur, about .18 mm. long; tarsus about .06 mm. long; claw about .02 mm. long, and rather stout; digitules of tarsus knobbed, long, and moderately stout; those on claw short and extending slightly beyond the claw. Anal ring with six hairs.

Egg.—The egg is smooth, elliptical in form, .33 mm. long, .21 mm. wide; color purple.

The Newly Hatched Larva.—Body subelliptical, very pale brown, .85 mm. long, .46 mm. wide, anterior end subparabolic. Antennæ very large, six-segmented, with a few scattered hairs; sixth segment longest, third next in length, first, second, and fifth subequal, fourth shortest,—formula 6, 3, 5, 2, 1, 4. Eyes inconspicuous. Mouth-parts well developed. Legs stout, well developed; coxa very stout, wider than long, with a few spiny hairs; trochanter triangular, with single short spiny hairs; femur the longest segment of the leg, but slightly narrower than the coxa; tibia shorter than femur and very much smaller, with a few short spiny hairs; tarsus shorter than tibia, tapering toward extremity, finished with a few spiny hairs, and four knobbed hairs, of which the lower pair are shorter, and with a short rather stout claw. Abdomen consists of nine segments, posterior end deeply emarginated, a long hair and a few spines on each projecting part. Anal ring with six long hairs.

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[1] One specimen examined had one antenna seven segmented, the other, only six-segmented, - formula $\left\{\begin{array}{l} 6,\ 3\ (1,\ 2)\ 5,\ 4 \\ 7,\ 2\ (1,\ 3)\ 6\ (4,\ 5) \end{array}\right.$

Habitat.—Found on grass *(Festuca scabrella)* on Black Mountain, Santa Clara County, California. The specimens were collected by the writer March 24, 1900,—eggs and newly hatched larva at the same time.

Lecanium adenostomæ, sp. nov.

Plate XXVI, Figs. 17–26.

Adult Female.—Shape subhemispherical, with the edges not flattened. Average length, 4 mm., width 3 mm., height, 2 mm. The shape and proportions vary somewhat according to the place upon which the scale formed. Color varies from light brown to dark brown, dorsal surface smooth. When removed from the twig there remains a little white cottony substance.

Antennæ rather small, seven-segmented, about .26 mm. long,—formula 3, 7, 4, 2 (5, 6) 1 (sometimes fourth segment longer than the seventh), third segment about .05 mm. in length, seventh with many rather long hairs, the others with but few. Legs small; coxa very stout, with a few long hairs; tibia about .09 mm. long; tarsus (without claw) about .045 mm. long, a few knobbed hairs on the extremity; claw stout and curved. Anal ring with eight long hairs.

Egg.—Elliptical in form, .3 mm. long and about one-third as wide; color, light reddish brown, with a peculiar curled marking.

The Newly Hatched Larva.—Body broadly elliptical, .38 mm. long, about .21 mm. wide, rounded in front and narrow behind; color, pale reddish brown, with legs and antennæ pale brown. Antennæ six-segmented, third segment longest, sixth next to the longest; sixth segment with several long hairs, the others with but few,—formula 3, 6, 2 (1, 4, 5). Eyes prominent, with red pigment. Mouth-parts and legs well developed. The three pairs of legs similar in form; coxa quite long, about one-half as thick as long, with one or two longish hairs; trochanter small and triangular in shape, with a single hair; the femur the longest joint of the leg, and almost equal to the coxa in diameter, with several long hairs; tibia a little shorter than femur, with a few long hairs; tarsus a little shorter than tibia, slightly tapering toward the extremity, which is furnished with a few spiny hairs and four knobbed hairs, or digitules, of which the lower pair are shortest, with a single rather long claw at the end.

Habitat and Life-History.—Found on *Adenostoma fasciculatum*, in the foot-hills of the Sierra Morena, Stanford University, and on Black Mountain, Santa Clara County, California. Taken by the writer March 24, 1900.

The female became mature about the latter part of March or the first of April. The eggs were laid irregularly beneath the body. The larvæ hatched from eggs, in the laboratory, for the first time, about May 1; they are very active. The male of this species is unknown.

Pseudolecanium tokionis *Ckll.*

PLATE XXVI, FIGS. 27-46.

Adult Female.—Length about 7 mm., width about 1.5 mm., very pale pinkish yellow (dried specimens dark brown), caudal end dark brown. Margin with capitate spines. Mouth-parts very small, but well chitinized. Antennæ very small, consisting of a single segment with a number of spines; two hairs on each side of dorsal aspect near caudal end; caudal end deeply cleft, with a number of long hairs on each side. Anal ring with twelve prominent hairs. The scale produces a white cottony secretion.

The Newly Hatched Larva.—Length .8 mm., breadth .29 mm. Color pale brown (the larvæ being dead when found, the fresh color is not known, but after boiling in K O H it is pale brown.); segments distinct; sides nearly straight, with capitated spines. Front margin of head round, with several capitated spines; mouth-parts large, well developed; eyes prominent, red. Antennæ .11 mm. in length, six-segmented, the segments very distinct, with strong constrictions between them, and each with a few prominent hairs; first segment stout, second smaller and shortest, about one-half the length of first, third a little longer than first, fourth shorter than third but longer than second, fifth slightly shorter than third, sixth as long as third,—formula usually 3, 6, 5, 1, 4, 2. Legs long and stout; coxa short and stout. Four capitate spines on dorsal aspect near caudal end, the extremity with a deep cleft, a small hair on each side, and two long caudal bristles; a row of short but stout spines along each side; anal ring without hair.

Second Larval Stage.—Length 1.16 mm., breadth .45 mm; color pale yellow, caudal end yellowish brown; margins with capitate hairs; legs wanting; antennæ consisting of a single segment as in the full grown female; segments distinct.

Cocoon of Male.—Length 1.50 mm., breadth .65 mm.; color white, subtransparent.

Male Pupa.—Length 1.04 mm., breadth .36 mm.; color pink, legs and antennæ pale brown; antennæ long and rather stout, reaching to base of second legs, nine-segmented, tapering toward extremity; wing-case narrow and long, reaching to the base of last leg; the coxa large, the tarsus slender, tapering, and without claw.

Adult Male.—Length about 1.4 mm., breadth .4 mm.; general color pink, with two basal segments of antennæ pink, while the other segments of antennæ and legs are pale brown. Head nearly round, pointed at front. Antennæ nine-segmented, reaching to the anterior part of the abdomen; first segment very stout, and shortest, second a little longer and more slender than first, third longest, and stoutest at apex, fourth, fifth and sixth nearly equal, and slightly shorter than third, seventh and eighth shorter than sixth, ninth shorter than eighth,—all are provided with short hairs. Eyes, three pairs, large and conspicuous, one pair on dorsal and one pair on ventral aspect pinkish, the pair on the side smaller and transparent. Prothorax narrow and short, mesothorax largest and well developed, metathorax shorter than mesothorax. Legs long and comparatively stout, with many hairs, the three pairs of legs similar, except that the front ones are directed forward, and the tarsi are the longest; the four posterior legs directed backward; coxa all stout and short; trochanter short and somewhat triangular in shape, closely united with femur; femur nearly three times as long as trochanter and stouter; tibia longer than femur and trochanter combined, more slender, with several spines along the inside and one long spine at the posterior end; tarsus less than one-half the length of tibia, except in the first pair, tapering toward tip, where it is terminated by a short movable claw with an enlarged base, and by four knobbed hairs. Wing, length .45 mm., width .10 mm., rather thick, transparent, narrow, and reaching to second or third abdominal segment, covered with many minute hairs, margins nearly straight. Balancers were not observed. Abdomen oval in shape and almost as wide as thorax, tapering toward extremity.

From the ninth segment is formed the penis, and its enlarged base is kept slightly within the eighth segment. The penis is in the form of a long, slender, tapering style, which enlarges a little at the tip.

Habitat.—Lives under sheathing bases of leaves of bamboo. The female always found with the head down.

This interesting insect was first discovered on bamboo, in Tokyo, Japan, by Mr. Takahashi, and was described in 1896 by Professor Cockerell,[1] of New Mexico, from dried specimens of full grown females with newly hatched larvæ. It was first found in this country by the writer, on the campus of Stanford University, February 19, 1899, this being the first time the male had been seen.

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[1] U. S. Dept. Agri., Divi. Ent., Technical, Ser. No. 4, 1896, p. 49.

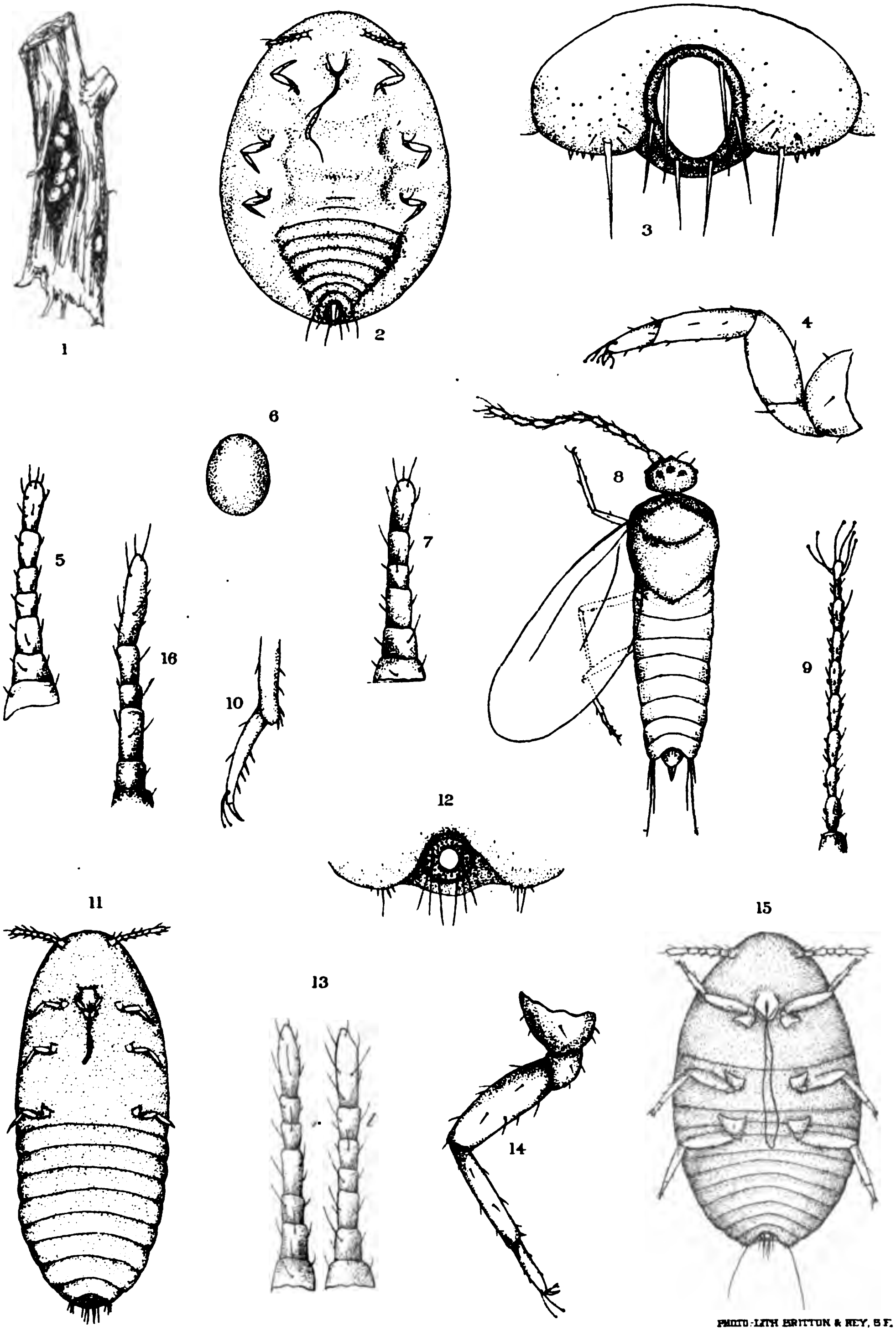
EXPLANATION OF PLATE XXV.

Eriococcus artemisiæ, sp. nov.

Fig. 1. A twig with female sacs.
Fig. 2. Adult female.
Fig. 3. Last abdominal segment of female.
Fig. 4. Leg of female.
Fig. 5. Antenna of female.
Fig. 6. Egg.
Fig. 7. Antenna of male larva.
Fig. 8. Adult male.
Fig. 9. Antenna of male.
Fig. 10. Tarsus of male.

Ripersia festucæ, sp. nov.

Fig. 11. Adult female.
Fig. 12. Last abdominal segment of female.
Fig. 13. Antennæ of female: *r*, right; *l*, left.
Fig. 14. Leg of female.
Fig. 15. First larval stage.
Fig. 16. Antenna of first larval stage.



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FIG'S. 1-10 ERIOCOCCUS ARTEMISIÆ, SP. NOV.
FIG'S. 11-16 RIPERSIA FESTUCÆ, SP. NOV.

EXPLANATION OF PLATE XXVI.

Lecanium adenostomæ, sp. nov.

Fig. 17. Female, ventral aspect.
Fig. 18. Last abdominal segment of female.
Fig. 19. Antenna of female.
Fig. 20. Leg of female.
Fig. 21. A group of spines of female.
Fig. 22. Marking on the dorsal aspect of female.
Fig. 23. Egg.
Fig. 24. First larval stage.
Fig. 25. Antenna of first larval stage.
Fig. 26. Tarsus of first larval stage.

Pseudolecanium tokionis Ckll.

Fig. 27. Females on bamboo.
Fig. 28. Specimen separated from host.
Fig. 29. Female.
Fig. 30. Dorsal aspect of last abdominal segment of female.
Fig. 31. Ventral aspect of last abdominal segment of female; all hairs but two removed from the anal ring.
Fig. 32. Antenna of female.
Fig. 33. Spines of female.
Fig. 34. First larval stage.
Fig. 35. Dorsal aspect of last abdominal segment of first larval stage.
Fig. 36. Leg of first larval stage.
Fig. 37. Antenna of first larval stage.
Fig. 38. Dorsal aspect of second larval stage.
Fig. 39. Dorsal aspect of last abdominal segment of second larval stage.
Fig. 40. Ventral aspect of last abdominal segment of second larval stage.
Fig. 41. Dorsal aspect of male pupa.
Fig. 42. Adult male.
Fig. 43. Dorsal aspect of head.
Fig. 44. Ventral aspect of head.
Fig. 45. Leg of male.
Fig. 46. Antenna of male.

THE REDWOOD MEALY BUG (DACTYLOPIUS SEQUOIÆ, SP. NOV.)

BY GEORGE A. COLEMAN.

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PREFATORY NOTE.

THE author's attention was first called to the Coccid described in this paper, in December, 1899, while searching for scales on a small isolated redwood tree *(Sequoia sempervirens)* on the grounds of Cedro Cottage Place, about one mile west of Stanford University. Early in January, 1900, the young were found making their appearance on the lower branches of redwoods, where the tree was thick and the insects well protected.

From this time on, the insects were under daily observation, both on their native trees and on potted branches in the laboratory, until the male and female were fully developed, the female had deposited her eggs, and the young were hatched and had passed into winter quarters. The descriptions of the various stages in the development of the male and female, and notes on the habits of this species, will occupy the major part of this paper.

I have to acknowledge my indebtedness to Mr. T. H. Pergande of the Division of Entomology, U. S. Department of Agriculture, who, after an examination of my specimens determines the scale to be new (with *D. citri* and *D. poæ* showing most resemblance to it).

This paper was prepared in the Entomological Laboratory of Stanford University, under the direction of Professor V. L. Kellogg.

I. DESCRIPTION OF THE SPECIES.

Dactylopius sequoiæ, sp. nov.

PLATE XXVII.

1. THE EGG.—The egg is ovate in form, averaging about .37 mm. in length, and .2 mm. in breadth at the widest part. In newly laid specimens the color is a transparent, light lemon yellow, but after a few days it gradually changes to a darker yellow, probably on account of the developing embryo showing through the transparent shell. The average number of eggs laid by each female is about seventy-five.

2. THE LARVA. (*First Stage*, fig. 1).—On emerging from the egg the young are very small, averaging about .4 mm. in length, and .2 mm. in breadth. The general shape of the body is elongate oval, widest at the middle, beginning to taper rather abruptly at a point about 5 μ distant from the middle on either side. The extremities of the body are slightly truncate. The color is at first a rather dark yellow, but soon changes to the characteristic grayish color. The integument of the young larva is quite transparent, revealing such of the internal organs as are not of themselves transparent.

The segments composing the body are not easily made out but seem to be at least thirteen, viz.: one to the head, three in the thorax, and nine abdominal, although the ninth is so closely associated with the eighth that it cannot be clearly distinguished. In specimens which subsequently develop into males, the lateral margins of each segment are furnished with a few slender spines, visible only under the high power of the microscope. These spines are not present in the female at any stage. There are about six short hairs, or spines, between the eyes, three on either side of the middle point. From either margin of the eighth abdominal segment there arises a conical protuberance, bearing a single long hair and two short ones about one-third the length of the long one. The caudo-ventral margin of the ninth segment bears the anal ring, a narrow, flattened, circular ring-plate, bearing the six slender, equidistant hairs, which are about .06 mm. in length. Protruding from this ring may be noticed a conical organ supposed to be the anus. The outer lobes of the ninth segment bend around until they are nearly on a level with the end of this organ.

The two eyes are situated on the cephalo-lateral angles of the head, and rather below the lateral line. They are not very prominent and show no dark pigment as in some other species. The mouth-parts are similar to those of the adult female, except that the buccal setæ are quite long, so that when doubled up in the body they reach to the last abdominal segment. The labium, or beak, is also large in proportion to the other parts.

The antennæ arise from the cephalo-lateral angles of the head, just in front of the eyes. They are about .15 mm. in length, of quite regular outline, and six-jointed. The formula is 6, 2, (3, 4, 5) 1; i. e., the sixth segment longest, the second next in length, segments three, four, and five about the same, and segment one the shortest. The antennæ are well supplied with hairs, the figure (fig. 1) showing their distribution.

The legs are nearly equal in size and shape, so that a description of one will answer practically for all. The coxa is quite large, rather broad at the base. The trochanter is also large, its angle being somewhat more than a right angle. The femur is longer and broader than any other segment.

The tibia is short and much wider at the lower end than at the upper. The tarsus is slightly longer than the tibia and terminates in a single, rather heavy claw. The coxa has no hairs. The trochanter bears one long hair on the outer side near its articulation with the femur. The femur has several short hairs. The tibia bears several hairs at each end. The tarsus also bears several hairs, and on the upper side a long hair ending in a knob. On the ventral side of the claw near its base are two digitules reaching somewhat beyond the claw and knobbed at their tips.

Second Stage.—The young grow very rapidly, the most marked change occurring about February 1, in the antennæ, which become seven-jointed by an elongation and division of the third segment. The formula now is 7, 3, 6, (1, 2, 4, 5). There is no change in the body or legs except the increase in size. The marginal spines of male specimens show distinctly.

3. DEVELOPMENT OF THE MALE (figs. 2, 3, 4).—Those individuals destined to become male flies continue to grow rapidly until about March 1, when they are considerably larger than the adult female. The segments of the body are now well developed and distinctly marked.

The marginal groups of five or six hairs each are now plainly visible on each abdominal segment. On each lateral margin of the eighth segment there is a group of about ten spines, and the marginal tubercle bears one long hair and three shorter ones. On each margin of the thoracic segment are three groups of from six to eight spines each. On the head there is a small group just above each eye, a large group near the base of each antennæ, and between the antennæ are four smaller groups.

The antennæ are now seven-jointed, formula 3, 7, (1, 2, 4, 5,) 6. They are also well supplied with hairs (fig. 2).

The legs are well developed; coxæ, trochanter, and femur being very stout, tibia and tarsus long and rather slender, the tarsus about two-thirds the length of the tibia. The claw is rather longer and more slender than that of the female, and it bears a short conical tooth on the ventral side near the distal end. The claw bears two knobbed digitules at its base which extend slightly beyond the end of the claw. All the segments of the legs are more or less covered with hairs which are arranged in rather definite rows.

The mouth-parts are not as large in proportion to the size of the body as in the female of about the same age, and markedly less so than in the adult female. The buccal setæ are especially short.

4. FORMATION OF THE PUPAL CASE (fig. 3).—About February 20, the male larvæ begin to secrete the waxy fibers for the cocoon. With this secretion there is a slight change in the form of the body. The ridge on the back is now quite pronounced, and there is a folding in of the integument near the dorso-lateral margin of each segment, so as to form a second ridge (fig. 3). The secreted fibers first appear at the lateral margins, and there form white plates extending out from the body at right angles. Gradually the whole body becomes enveloped in a white waxy cocoon of semicylindrical shape, slightly conical at the lower end, and bearing two projecting tubes, in which the long waxy caudal filaments are formed. There are also two projections at the cephalic end enclosing the antennæ.

5. THE PUPA (fig. 4).—On examining a somewhat advanced pupa, we notice, first, a general change in form. The head has become much reduced in size and contracted in form, being now very distinctly separated from the prothorax, which is also smaller, and quite distinctly marked off from the mesothorax. The wing-pads are well developed. The lateral margins of the fifth, sixth, and seventh abdominal segments are marked by large tubercles, each bearing a single stout spine. The anal projection of the ninth segment is prominent, and the penis and other reproductive organs have begun to develop. The anal ring and hairs have disappeared, as have also the mouth-parts. The ocelli are not yet visible, although there are indications of them.

The antennæ are noticeably longer and although still enclosed in their pupal sheath show plainly the ten joints and the numerous hairs which are still compressed in the enveloping sheath. The legs are longer and more slender than in the larval stage.

The pupa at this stage is of a grayish purple color, and the body is covered with short fine hairs.

6. The Adult Male (fig. 5).—The following description was drawn from living specimens:—

Measurements:—Body, from tip of head to tip of abdomen, 3 mm.; caudal lobe, .5 mm.; from tip of head to end of folded wing, along dorso-median line, 5 mm.; antennæ, 3.48 mm.; wings, length, 3.4 mm., width 1.4 mm.; front legs, femur, .6 mm, tibia .9 mm.; tarsus .3 mm., claw .07 mm.; hind legs, femur .8 mm., tibia .1 mm., tarsus .33 mm., claw .08 mm.

Color:—Head, dark olivaceous; eyes, blackish; thorax olivaceous; abdomen, light olivaceous with yellowish tinge; caudal filaments white; legs, olivaceous; wings, semitransparent, smoky, with iridescent rose tint in strong light.

Balancers stout, with three long hooked claws fitting into socket in wing (fig. 5, *a*).

The head is very much reduced, in fact, it seems to serve simply as the seat for the eyes and the antennæ. It is longitudinally bisected by a distinct groove, ending posteriorly on the ventral side in a triangular depression occupying the position of the obsolete mouth-parts. On each lateral half of the head there are seven ocelli arranged in a transverse line just back of the antennæ. Posterior to the middle one of these ocelli there is, on either side, a single large ocellus. The antennæ are ten-jointed, formula, 4, (3, 5, 6,) 7, 8, 9, 10, 2, 1. All segments have numerous hairs.

The legs are very slender, covered with rather long slender hairs for their entire length. The tarsi are armed on either side with a ventro-lateral row of short stiff spines. The tibia have also a few short spines on the ventro-lateral margins of the distal half. The claws are rather slender, with a slight tooth on the ventral side near the tip. The two digitules are present at the base, though not perceptibly knobbed.

7. THE ADULT FEMALE (fig. 6).— The adult female just before impregnation is rather long and slender as compared with the male propupa stage. The length is then about 1.8 mm., width about 1 mm. After impregnation there is a considerable shortening of the body and a consequent broadening as the eggs develop. The shape of the unimpregnated female is almost a perfect oval as to dorsal and lateral outlines, the ventral a nearly flat surface.

In the live insect the color is a characteristic gray. The abdominal segments are distinctly marked dorsally, although the lateral margins show almost no indentation.

The antennæ are rather slender, about .65 mm. in length, and eight-jointed,—formula, 8, (2, 3,) 7, (4, 5, 6,) 1. The number of hairs and their arrangement on the segments are about as described for the first larval stage. The eyes are prominent though not very large. The legs have not developed in proportion to the size of the body. The shape and relative lengths of the different segments are about as in the first larval stage, except that the tibiæ are now longer than the tarsi. The claws terminate in distinct hooks and have the two knobbed hairs, or digitules, at the base on the ventral side. There is a single long hair at the distal end of the tarsus, on the dorsal side (fig. 6, *a*).

The anal ring bears six long hairs as in the young, and the marginal lobes of the eighth segment each bear a single long hair, with two shorter ones at the base.

The head, thorax, and abdomen are covered with short hairs, and on the caudal margin of each abdominal segment is a row of longer hairs. A few scattering long hairs are visible on the thorax and head.

II. LIFE-HISTORY AND HABITS.

1. THE YOUNG LARVA.—The young larvæ within the egg-sac were quite active soon after hatching, crawling about over the unhatched eggs. In a few days they left the egg-sac and ran about over the leaves and twigs. In a week or ten days after the first young appeared all were hatched and had entirely deserted the egg-sac. Those hatching on

potted branches in the laboratory all left the branches and disappeared in a few days.

June 1, 1900, I marked several females on a redwood tree at Cedro Cottage Place, which were just beginning to secrete ovisac. I watched them until the young had disappeared from the egg-sac, and although I searched very carefully for these young on leaves and branches none was found.

In January, 1901, I found the young insects abundant on this same tree and of exactly the same form as the just hatched larva, the antennæ still being six-jointed and of the same formula, legs the same shape. The only change that had taken place was that they had grown to nearly twice the size of the very young stage. They must, therefore, conceal themselves on the branches or in the bracts at the base of the leaves on the lower branches, where they are thick and protected. There they lead a semiquiescent life for a period of about six months. In the first days of January they began to crawl about and were easily found, always, however, partially concealed at the base of the needles.

2. SECOND LARVAL STAGE.—These larvæ grew quite rapidly, and about February 1 the antennæ became seven-jointed. There was, however, no perceptible change in form at this time. Possibly a third change may be noticed in the male just before pupation, but it is very slight. In the course of these three stages I have not actually observed any moulting.

3. THE MALE PUPA.—The male begins to secrete the wax for its cocoon about February 20, and I have found the completed cocoons by March 1. Now begins the radical transformation of the male larva, a complete metamorphosis being undergone before the fly issues. The whole process occupies a period of about twenty days.

The process of emerging from the pupal case and skin is very interesting. On March 21, at nine a. m., I found the young male in the cocoon which was completed March 1 to be in the act of emerging. The pupal skin first split along the dorso-median line of the head. The head suddenly burst through, next the wings, then the legs. In the process, the skin became exactly reversed, leaving the abdomen attached until the very last thing. The male had entirely freed himself from the skin by twelve o'clock, and soon began to move the legs and antennæ, at first very feebly, gradually increasing the movements as he gained strength.

The process of the unfolding of the wings is also very interesting. In a few minutes after the male emerged, the wing-pads began to swell up at the base, and proceeded to expand in much the same way that a balloon does in being inflated with gas. The swelling passed rapidly from base to apex of wing, the wing expanding at the same time. This process occupied about fifteen minutes, although the full expansion of the wing was not complete until the following morning.

The long waxy caudal filaments were at first folded up and it took some time for them to straighten out.

Soon after emergence the male began to move about quite actively, walking with wings extended at an angle of about forty-five degrees above a horizontal plane. The long white filaments were also extended at an angle of about thirty degrees and directed slightly upward, giving him a very graceful appearance.

When approaching a female, the antennæ were used to discover her definite location, and there was a rapid vibration of the wings when he first found her. I reared a number of males in glass breeding jars, and in no case did I observe even a short flight, or attempt to fly, although I shook the jar and even touched the insects with a needle.

From my observations, I should say that the males live on an average for three days after maturity; the longest record I have is four days, and the shortest, two days.

4. THE FEMALE AND OVISAC (fig. 7).—The females began to secrete ovisac about April 1. The first appearance of it was a little white fringe of waxy filaments protruding from the ventral margins of the three caudal segments of the abdomen. As the process of secretion continued and the ovisac grew in length and thickness, the abdomen of the female was gradually raised up so that it finally stood nearly at right angles to the natural position. In about two days

the proximal third of the ovisac was completed, and the egg-laying process began. No eggs, however, were deposited in the proximal third, the eggs being deposited in the remainder of the sac as it was completed. The whole process occupied about five or six days.

The first young appeared in about twenty days and in two or three days more all had hatched. The mother insect usually lives for several days after the young are hatched. In one case she survived for ten days after all young were hatched. The larger number of females come to maturity in April and the first part of May; but there are stragglers until late in June and even a few in July. However, the great bulk of the young appear about the middle of May.

5. DISTRIBUTION.—I found the first specimens of this species in December, 1899, on a small, isolated, cultivated redwood tree *(Sequoia sempervirens)* on the grounds at Cedro Cottage Place, one mile west of Stanford University. Later, I found them on a well protected redwood tree in the Stanford Arboretum. A few scattering specimens were found on other redwood trees in the arboretum, but they were most abundant on the single tree mentioned.

March 1, 1900, I found the young quite abundant on a clump of young redwoods at Woodside, about six miles west of the University, near the foot-hills. A curious fact with reference to these last mentioned individuals is that they nearly all developed into males, the proportion being about ten males to one female. On the tree in the arboretum exactly the reverse of this is true.

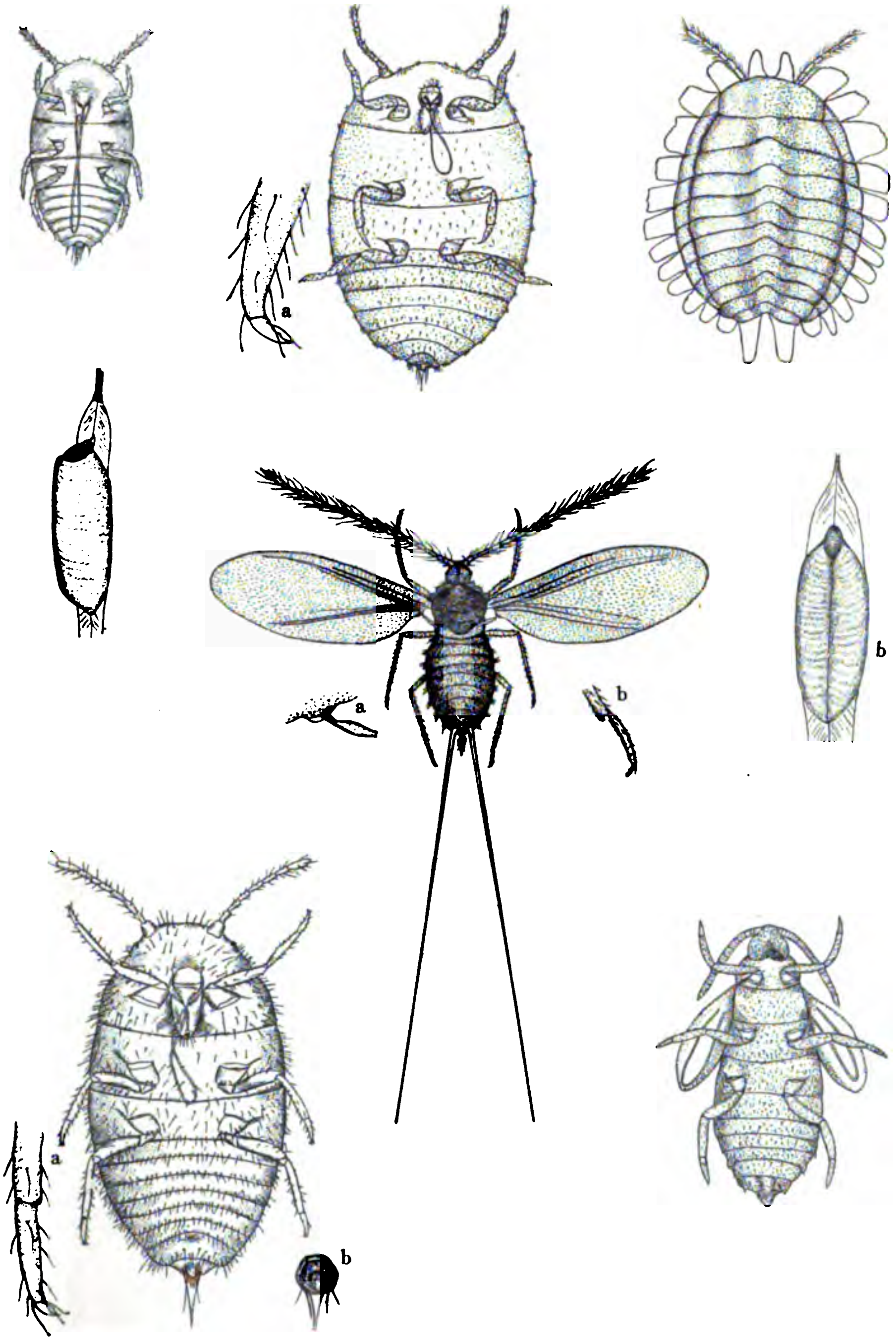
I have since found this scale all through the Sierra Morena Mountains, extending to the coast, and for a distance of from ten to sixty miles from Stanford University, wherever there are redwood trees. They do not seem to be abundant in any locality.

6. PARASITES.—I have found the larva of a ladybird, species as yet undetermined, eating the young and using the waxy filaments of the egg-sac for its own cocoon. I have also bred from the body of the female scale a Chalcid fly, of which the species has not yet been determined.

EXPLANATION OF PLATE XXVII.

Dactylopius sequoiæ, sp. nov.

Fig. 1. Larva, first stage.
Fig. 2. Male larva, propupa stage: *a*, enlarged tarsus and claw.
Fig. 3. Male larva beginning to secrete wax for cocoon.
Fig. 4. Male pupa, advanced stage.
Fig. 5. Adult male: *a*, balancer and pocket; *b*, enlarged tarsus and claw.
Fig. 6. Adult female: *a*, enlarged tarsus and claw; *b*, anal ring and hairs.
Fig. 7. Adult female and ovisac: *a*, lateral view; *b*, dorsal view.



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DACTYLOPIUS SEQUOIAE, SP. NOV.

THE SAN JOSE SCALE IN JAPAN.

BY SHINKAI INOKICHI KUWANA.

I. PREFATORY NOTE.

THE insidious invasion of the eastern United States by the San Jose scale *(Aspidiotus perniciosus)* has come to be so formidable that the pest is now recognized as one of the most seriously threatening dangers to American fruits. In thirty-five or more States and Territories, and in Canada, the insect is recognized as a scourge. The invasion has been met by the active antagonism of economic entomologists, State Legislatures and fruit growers. A dozen or more States have passed laws providing for the inspection of nursery stock and fruits brought into the State, and for the destruction of stock found to be infested by the scale. The life history of the insect has been carefully studied, the effects of new climatic and topographic environment noted, and new remedies devised and tested.

It is recognized more clearly to-day than ever before, how all-important in keeping insect pests in check are their natural enemies, predaceous and parasitic. One of the promising lines of work in economic entomology is the search for and the importation and propagation of the natural enemies (usually predaceous or parasitic insects) of introduced foreign pests. The too successful naturalization of these foreigners is in most instances due, presumably, to the fact that they come to us unaccompanied by their natural native enemies. Free from the principal check to their increase, they multiply and spread with alarming rapidity (providing the conditions of climate and typography permit), giving us a momentary glimpse of life uncontrolled by the balance wheel of one phase of the struggle for existence. It is quite true that much that is ill-considered and imaginative has been spoken and written regarding the success of the importation of parasites. And the expectations of the uninformed, or rather of the falsely informed, are hardly likely to be met soon. But there is an encouraging residuum of fact left, after the froth and bubble have been blown from the California stories. The *Vedalia* has really eaten up about all the cottony cushion scale *(Icerya)*; and some other imported lady-birds are really eating up other scales. I believe that it is at least worth while to see if there is any hope of getting some active and competent Chalcid parasite or lady-bird beetle to look after the San Jose scale.

But to search for the native enemies of the San Jose scale it is necessary to know the nativity of the scale itself, and this is something as yet undetermined. Without canvassing in detail opposing claims for the honor, it is sufficient to say that Japan and California are the two leading claimants in the matter, each claiming that the other is the native home of the pest. With the hope of settling definitely the moot question of the actual occurrence in Japan of the San Jose scale and if possible of determining, if the scale was found to occur there, whether it is native to Japan or not, and finally with the hope of finding an effective natural enemy of the scale, Mr. Shinkai I. Kuwana, assistant in entomology at Stanford University, spent all of last summer in Japan collecting and studying in the field the Japanese scale insects (the first attempt at a systematic investigation of the Japanese Coccidæ), giving his special attention to the San Jose scale. Mr. Kuwana's collections are large, and his notes many and interesting. His familiarity with the language, the customs and the geography of Japan gave him special advantages in the work. He visited all of the large islands of the empire, penetrating into the interior among the mountains, as well as examining the coast-line orchards.

The present paper is an account of his observations on the occurrence and distribution of the San Jose scale in Japan, together with some notes on the variation of the species, and some observations on the parasites and predaceous enemies of the scale in Japan. Mr. Kuwana's observations determine definitely the widespread occurrence of the scale throughout the Japanese islands, and point strongly to the Japanese nativity of the species. He also has found several natural enemies of the scale of which two are sufficiently effective to keep the pest in check throughout most of the empire. It may be noted that Mr. Kuwana's Japanese specimens of the San Jose scale have been compared with authoritatively determined American specimens by himself and by me, as well as by Mr. C. L. Marlatt, first assistant in the Division of Entomology, U. S. Department of Agriculture, and that there is no doubt of the reference of the Japanese specimens to this species. For that matter the drawings represented in figure 1 on page 13 of the present paper make the determination of the species apparent to any student of the Coccidæ.

VERNON L. KELLOGG.

2. REPORT.

Arriving at Yokohama on June 6, 1900, I spent all the time until August 25 traveling and collecting, visiting orchards and making occasional trips into the native forests. I visited and collected on all the main islands of the empire, excepting Shikoku. Much aid was given me by orchard growers and by numerous intelligent countrymen who were interested in my work. Among the many who kindly assisted me I may particularly mention Mr. Suguya Hori, entomologist of the Central Agricultural Experimental Station, Mr. K. Abe of Kokura, owner of large orchards, and Mr. Y. Nawa, an entomologist of Gifu. I wish also to express my obligations to Hon. S. Fujita, Vice-minister of Agriculture and Commerce, whose courtesies and kindness were of great advantage to me in my work.

DISTRIBUTION AND PRESENT STATUS OF THE SAN JOSE SCALE IN JAPAN.

The facts relating to the past and present occurrence and distribution of the San Jose scale in Japan as determined by me on this trip are presented under the following locality heads. By reference to a map of Japan, the distribution of the scale as given in these notes may be more readily understood.

KIUSHIU ISLAND.

Hukuoka-Ken.

Kokura (City).—Mr. Abe has here an orchard of 10,000 pear trees and many other fruit trees. The orchard is about six years old, and the stock came from M. Suzuki's nursery in Saitama-Ken. Mr. Abe found the San Jose scale in his orchard in 1899, some of the pear trees being then very badly infested and many trees dying. He had sprayed with kerosene and other mixtures. However, because of an imperfect spraying machine and the wonderful reproductive power of this insect, the scale spread more and more. In the spring of 1900 he dug up and burned more than three hundred trees. There are still many trees very badly infested, especially on the trunk and small branches. Near the pear trees are some plum trees which came from Kumamoto. Those trees are older than the pear and are badly infested by other kinds of scale insects.

Hukuoka (City).—On the grounds of the Agricultural Experiment Station are some small orchards containing pear, peach, and other fruit trees. A careful examination of them revealed no San Jose scale.

Kato-mura (Near Hukuoka City).—An old pear tree, about forty-five to fifty years old, stands by itself east of a farmer's house, by a small ditch. It is about twelve inches in diameter, is very old, has never been pruned and is native to the place. This old tree is very badly infested by the San Jose scale. The scales covered the branches and were abundant even on the leaves and fruit.

HONDO ISLAND.

Shiga-Ken.

Shiga-Ken Agricultural Experiment Station (near Otsu City).—On a quince tree about ten years old, standing in front of the office, I found the San Jose scale. The insect was most abundant at the base of the trunk. On the south side of the building is an orchard of pear, plum, peach and apple trees. The apples were attacked by the scale. The stock came from Konoyen, Tokyo. I am pretty sure the scale was introduced here by the stock.

Gifu-Ken.

Kuise-mura (near Gifu City).—There are many small pear orchards. Some of them are very old. I found the San Jose scale in every one of them. In this region the scale has been known for more than thirty years, being called *Ki-abura.*

Tokyo (City).—In a green-house in Shokubutsu Gyo-yen, Shinjiku, there are fourteen peach trees about four years old, which were grafted in the house. These trees are infested by the scale. On the lower part of the trunks most of the scales had died and dropped off leaving round white marks, but on the upper part and on the branches they were alive, and some young scales were noticeable on this year's growth. Next to the peach-tree room were a dozen grape vines free from the scale, and in the yard some apple trees with but very few scales.

Mita Ikushujo (Mita Nursery), in Tokyo City, was established some twenty years ago and is one of the oldest nurseries in Japan. From here all kinds of fruit trees are sent to nearly all parts of Japan. The foreign seeds and stock are chiefly imported from New York, Philadelphia and California. The principal places to which the fruit trees are sent are as follows:—

Apple trees—Aomori, Hokkaido, Iwate, Akita, and Yamagata-Ken.
American pear trees—Okayama-Ken.
Orange and peach trees—Wakayama-Ken.
Peach, pear and apple trees—Hukuoka-Ken.
Pear and apple trees—Hiroshima-Ken.
Orange trees—Saga-Ken.

In the back yard of the nursery there was growing in a pot a small pear tree about seven years old, which was very badly infested by the San Jose scale.

Kawasaki (near Tokyo).—This has been a noted place for pears since the time of Tokugawa (1700). It is situated between Tokyo and Yokohama. On July 22d, I accompanied Mr. Hori, entomologist in the Central Agricultural Station, to Kawasaki to examine the pear orchards. Here I found the San Jose scale in very old orchards, but not very abundant. In the orchard of the Agricultural College, I found the scale quite numerous on apple trees about five years old.

Yokohoma.—The Yokohoma Nursery Company is the largest one in Japan. Its principal business is exporting flowering plants, ornamental trees and fruit trees of all kinds. I spent nearly all day in the garden and greenhouse, and collected many kinds of scales from all kinds of trees, shrubs and plants. Among a large number of plum, cherry, quince *(Kaido)* and other trees in pots, I found an old Japanese quince *(Kaido)* infested by the San Jose scale. The scales were more numerous toward the base of the trunk and on exposed parts of roots. A Japanese pear tree in a pot, about six years old, was also infested by the San Jose scale. The tree came from Angio, Saitama-Ken.

A careful inspection of twenty California peach trees, which had been brought to Japan by Mr. Suzuki, the manager of the Nursery, in 1893, when returning from the World's Fair at Chicago, discovered no San Jose scale, but another scale (*Diaspis amygdali* Tryon) was quite abundant.

Since certain entomologists have reported that Japan was supposed to be the original home of the San Jose scale, all plants exported are very severely examined at foreign ports. On November 15, 1899, the Yokohoma Nursery Company sent the following plants and trees to Germany: 20 *Magnolia obovata;* 10 *Bambusa aurea;* 10 *B. snochiku;* 10 *Phyllostachys nigra;* 10 *P. guilioi;* 25 *Prunus pendula;* 180 *Acer osakazuki;* 25 *Prunus mume* (white); 25 *P. mume* (red); 25 *P. mume* (red purple); 30 *Prunus pseudocerasus;* 30 *P. pseudocerasus* (pink); 10 *P. pseudocerasus* (greenish yellow); 5 *Acer aureum;* 5 *A. reticulatum;*

30 *A. sanguineum;* 30 *A.* sp. After inspection in Germany these trees were destroyed because of the presence on them of the San Jose scale.

Saitama-Ken.

Angio-mura.—About 10 miles north of Tokyo is the largest nursery in the vicinity. Nearly all the nursery stock in the Tokyo market has come from this place. Here I found on only one pear tree among a thousand trees two individuals of the San Jose scale, but they were dead, having been attacked by parasites.

Miyagi-Ken.

Sendai (City).—In the orchards at Hichiken-cho, city, I found the San Jose scale on pear and apple trees. The orchards contained about 500 trees, about six years old. The stock came from Yowagata-Ken. Pear and apple trees in the yard of Mr. Matsukura were free from the scale, except a young pear tree about four years old, which was very badly infested with the San Jose scale.

Nanaai-mura (near Sendai City).—In a pear orchard containing about 15,000 trees, from eight to twenty years old, many of the trees were attacked by the San Jose scale. I particularly noticed a tree, about eight years old, which had been cut off about four feet above the ground and grafted on the top, the graft being protected with straw. The trunk under the straw was thickly covered with the scales, but on the young new shoots there were very few.

Miyagi-Ken Agricultural school (near Sendai City).—In front of the main building are several apple trees and one American pear tree infested by the San Jose scale. The trees are not older than ten years.

Hayakawa's orchard (near Sendai City).—This orchard contains pear, peach and apple trees, planted about twenty-two years ago. The pear trees are infested by the scale, but the scale does not seem to multiply very fast here.

Iwate-Ken.

Morioka (City).—I examined Mr. Furukawa's orchard and found the San Jose scale on the apple trees, but not numerous. It is the oldest orchard in the *ken*, being about twenty-five years old. The stock was sent from *Kwaitakushi*, Tokyo, to experiment with foreign fruit trees in that region. The original stock came from America and the *Kwaitakushi* sent it all over the country. Mr. Furukawa received 3,000 trees. In a group of about a dozen wild pear trees I found one very badly infested by the San Jose scale, every part of the tree being covered, even to the roots, which were exposed above the soil. These trees had been brought from a mountain about four miles from the city and were to be grafted. However, many female scales remained on the tree with a small hole in each, through which, no doubt, the parasite had escaped. It was the first time I had seen the scales severely attacked by parasites. I went through many orchards about the city and found the San Jose scale in every orchard. I desired very much to go to the mountain to investigate the condition of wild pear trees, but time would not permit.

Aomori-Ken.

Aomori (City).—In the city I found the San Jose scale on the apple and currant bushes.

Hirosaki.—Nowhere else were apple trees so badly infested with the San Jose scale as here, especially in Mr. Kikuchi's orchard.

HOKKAIDO ISLAND.

Sapporo (City).—Here I found very old orchards in which the stock came directly from America. I took great pains to examine the old trees (over 20 years old), but found no San Jose scale, although *Mytilaspis pomorus* was very common.

Orchard of Agricultural College.—Consists of nearly all kinds of fruit trees. I examined tree after tree and found a few apple trees with San Jose scale. Great care has been taken to keep the insect from spreading.

NOTES AND OPINIONS OF JAPANESE OBSERVERS.

The following notes are abstracted and translated from Japanese papers:

In "The Japanese Agriculture"[1] Professor M. Matsumura has an article about beneficial insects. He says: "This insect [San Jose scale] was introduced into Japan some ten years ago, the original home being still unknown. But some think it is native of Japan, and the reason that it is not so injurious here is that there is a species of lady-bug which is destructive to the scale. I have not seen this insect near Tokyo, but I have seen it in Aomori-Ken and Hokkaido."

In a letter received from Professor Matsumura, dated Dec. 3, 1898, he says: "Dr. L. O. Howard and Professor J. B. Smith have written to me saying that the San Jose scale is a native to Japan; but I have heard since that it is native to Australia. I sincerely believe that this scale [San Jose] was imported into Japan."

July 7, 1899, Mr. S. Onuki, Entomologist of the Nishigahora or Central Agricultural Experiment Station, Tokyo, in answer to the request of the foreign department of Japan, as to the San Jose scale, replied as follows: "In reply to your request in letter No. 256, I beg to say that after careful investigation the San Jose scale has not been found in Japan as yet, therefore it cannot be a native of Japan. However, there is a species of scale insect which is closely related to the San Jose scale, called *Diaspis amygdali*, a very injurious pest, which attacks many kinds of trees, etc."

In the Report of the Agricultural Society of Japan,[2] (Dai Nippon No Kwai) Professor C. Sasaki, of the Agricultural College, Imperial University, says as follows: "At present the San Jose scale is being discussed a great deal in America. This scale has infested many kinds of trees in America and is a very injurious pest. It is not native to America, but was imported from some foreign country. Some say it was introduced from Australia, while others say from Japan, but its home is not definitely known. The German government made a law that all fruits and fruit trees imported from America must be carefully examined to prevent the scale from entering Germany. That government desiring to be assured whether the scale came also from Japan sent a letter of inquiry to this government. That letter came to my hand. Being confident that the San Jose scale did not exist in Japan, I answered that the scale insect which is being so much discussed in America is not found in Japan; but there is a species of scale insect here which is just as injurious as the San Jose scale. American entomologists may have mistaken this insect for the San Jose scale, but, from scientific investigation, I think it safe to say that the San Jose scale is, up to date, not found in Japan. However, this scale [*Diaspis amygdali ?*], which is very closely related to the San Jose scale, is very common in Japan, and is found on plum, cherry, peach, pear and mulberry trees. The plum and peach trees are badly infested, also the mulberry in Hukushima-Ken, so that sometimes the trees die, etc.''

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[1] Vol. IV, No. 6, pp. 74, 75, Aug. 15, 1897.

[2] No. 215, Aug. 1899, p. 4.

In an article which appeared in ''The Insect World,''[1] containing a list of Japanese scales that are known in America, I mentioned the San Jose scale as follows:—''This scale was sent to me by Mr. M. Nawa, Gifu, Japan, last winter. He found it in an orchard near Gifu City. Its native home may be South America or Australia, and possibly it has been introduced into Japan from some foreign country.''

Mr. K. Abe, President of the Hukuoka-Ken Agricultural Society, said that since he had found the scale in his own orchard, he had traveled nearly all over Kiushiu, and noticed that many native pear trees in many places were attacked by this scale. He said that he believes that this insect is a native and not introduced from a foreign country. Mr. Abe found this same pest on a tree nearly a hundred years old, with no possible chance of its having come in contact with foreign or native fruit trees that were infested. He said, "The reason we did not know this insect until to-day is because it is so small, and so hard to see."

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[1] Vol. III, No. 12, Dec. 15, 1899, p. 452.

On June 12, 1900, I called upon Professor M. Miyoshi, at Koishikawa Botanical Garden, Imperial University, Tokyo. He said that last winter Professor Treub, Director of the Botanical Garden, Buitenzorg, Java, sent a letter (dated Jan. 15) to him asking whether the San Jose scale insect existed in Japan, and if it did, whether it was native to Japan. Professor Miyoshi, knowing nothing about the scale, wrote to Professor Sasaki, Professor Matsumura, and Mr. Nawa, asking about this matter. Professor Sasaki answered February 10, 1900, saying that it was not known to exist in Japan, but the matter was being investigated. Professor Matsumura, under date of February 12th, writes, "It does not exist in Japan," and February 29th, Mr. Nawa wrote, "not certain."

Mr. Kikuchi Hirosaki thinks it is native to that part of the country and has existed there many years, but it has become worse since the importation of foreign fruit trees. The reason for this is that the foreign trees being younger and more tender are attacked by the insect in preference to the old native ones.

FOOD PLANTS.

I found the San Jose scale on the following hosts in Japan: pear, apple, plum, peach, Japanese quince, currant, willow *(Salix gracilistyla)*, *Pilea pumila* and *Pæonia moutan*.

PARASITES AND NATURAL ENEMIES.

One species of Aphelinid fly (species undetermined) is a common parasite. Many of my mounted specimens of the San Jose scale have the pupa of the Aphelinid in the body of the female. The parasite seems to do effective work.

As to the predaceous insect enemies, I have found two species of lady-bird beetles (Coccinellidæ) and one Nitidulid (*Cybocephalus*, sp.).

Of these, one of the Coccinellids is particularly abundant and does destructive work. It not only feeds upon the San Jose scale but upon other scales also. I can add the larva of a kind of moth which seems to feed on the scale. I did not notice it while collecting, but upon examination of the collection, many pupa-cases of moth have been found among the scales. The pupa case is in a silken cocoon which was spun beneath the scale masses.

REMEDIES THAT HAVE BEEN USED IN JAPAN FOR THE SCALE.

As yet neither good spraying machines nor the best insecticides have been used for the destruction of the scale, therefore it has spread as much as has been permitted by nature. However, the farmer uses a few simple methods of destroying the pests, such as soap water, solution of caustic soda, kerosene and kerosene mixture.

The soap water, kerosene, and kerosene mixture are applied with a Japanese paint brush. It is a primitive way that often kills the small branches without affecting the insects. The solution of caustic soda (one pound of caustic soda to about ten gallons of water) is applied with cloths and then the trees are washed with pure water.

After rain the farmers go out into the orchards with ropes or cloths and rub off the scales while they are wet.

With proper methods of fighting the scale, aiding in the work of its natural enemies, the San Jose scale could be kept in check in Japan.

VARIATION IN THE SPECIES.

A large number of specimens from different parts of Japan have been studied. The scales are uniformly dark, either black or dark brown. The white secretion covering the exuviæ of males is comparatively scanty, in some cases almost wanting, leaving the black sculptured ring and dot; in some cases only the white dot is shown plainly; others, however, have dot and ring very distinctly marked.

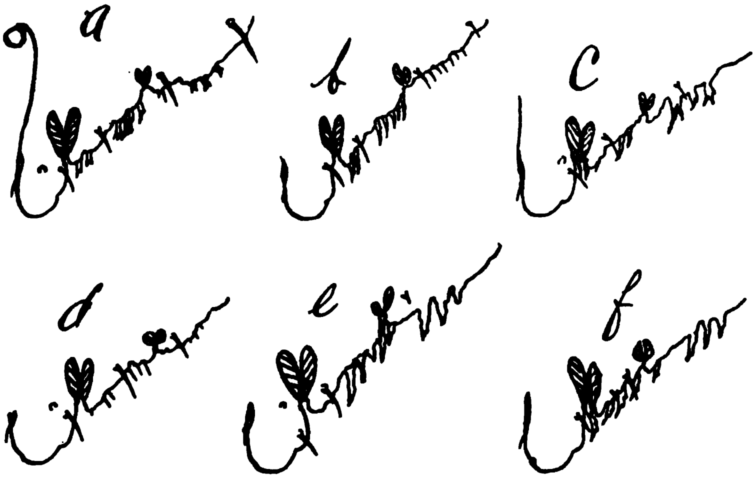

FIG. 1. San Jose scale (*Aspidiotus perniciosus* Comst.); half of caudal margin of female abdomen of various specimens taken from different localities; *a*, from Georgia, U. S. A. (Determined by Dr. L. O. Howard); *b* and *c*, from Hukuoka-Ken, Japan; *d*, from Gifu-Ken, Japan; *e*, from Aomori, Japan; *f*, from Hokkaido, Japan.

There are also some variations in the last abdominal segment of females, not even the two sides of the same insect being equal. But the relative size of the chitinous processes between the first and second lobe remain the same, "close together and nearly equal in size." The small chitinous processes of the second incision are always present. The anal plates of the female are so variable in number, size and shape that an insect with both sides equal is seldom found. Some cases show the forks in the plates while others do not. The accompanying figure (fig. 1) shows the variation.

SUMMARY.

My investigation of the San Jose scale in Japan, during the summer of 1900, may be briefly summarized as follows:

1. The San Jose scale was found by me in all the main islands (except Shikoku, which was not visited).

2. Some orchards are completely ruined by it, others only slightly affected. With the exception of a few places the scale is not abundant enough anywhere in Japan to endanger the orchards.

3. In Kiushiu, the pear trees are the most affected by the scale, while in the northern part of Hondo (Sendai, Morioka and Aomori) the apple trees are the worst sufferers.

4. The San Jose scale was not found in the oldest orchard (apple) in Hokkaido. The stock for this orchard was imported from America some twenty-five years ago.

5. In some places the scale has been known for more than thirty years, being called Ki-Abura.

6. The scale is not found on the high elevations.

7. In many cases the scale is attacked by parasites, in some instances nearly all the female scales being infested.

8. Found no wild tree attacked by the scale.

9. There is no good spraying apparatus in use nor effective insecticides to keep the pest in check.

(*Continued from Second Page of Cover.*)

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OF THE
LELAND STANFORD JR. UNIVERSITY

XXV

Notes on Coccidæ (Scale Insects)

FROM THE
Entomological Laboratory, Leland Stanford Jr. University

Comprising

NOTES ON CEROCOCCUS
BY
ROSE W. PATTERSON

NEW AND LITTLE KNOWN CALIFORNIA COCCIDÆ
BY
S. I. KUWANA

THE REDWOOD MEALY BUG *(Dactylopius sequoiæ sp. nov.)*
BY
GEORGE A. COLEMAN

THE SAN JOSE SCALE IN JAPAN
BY
S. I. KUWANA

[First, second and third papers reprinted from the Proceedings of the California Academy of Sciences, 3d Ser., Zoology, Vol. II]

STANFORD UNIVERSITY, CALIFORNIA
1901

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(*Continued on Third Page of Cover.*)

CONTRIBUTIONS TO BIOLOGY
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XXVI

Studies on Ciliate Infusoria

BY

N. M. STEVENS

[Reprinted from the Proceedings of the California Academy of Sciences
3d Ser. Zoology, Vol. III]

STANFORD UNIVERSITY, CALIFORNIA
1901

PREFATORY NOTE.

This memoir is the twenty-seventh of a series designed to illustrate investigations and explorations connected with the Hopkins Seaside Laboratory, an adjunct of the biological laboratories of the Leland Stanford Junior University. These investigations have been carried on by means of the assistance given by Timothy Hopkins, Esq., of Menlo Park, California. This memoir appears in the publications of the California Academy of Sciences, the present edition being a reprint.

OLIVER P. JENKINS,
CHARLES H. GILBERT,
Directors Hopkins Laboratory.

Date of publication, March 4, 1902.

COCCIDÆ (SCALE INSECTS) OF JAPAN.

BY SHINKAI INOKICHI KUWANA,

Assistant in Entomology, Leland Stanford Jr. University.

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January 21, 1902.

I. INTRODUCTION.

THE Coccidæ (Scale Insects) described and identified in this paper were collected by the author in Japan in the summer of 1900, between June 6th and August 25th. This collecting expedition was made partly on behalf of Stanford University, and partly as the personal undertaking of the author. Collections were made on all of the main islands of the Empire, excepting Shikoku; but as the time was limited, only the principal agricultural districts of each island could be visited, although it was sometimes possible to penetrate into the wild forests when situated conveniently near the railways. The writer was not able to reach several important places in the southern part of Kiushiu Island and in Sanin and Hokurikudo of Hondo (Honshu), nor could Formosa be visited. As special attention was being paid to the distribution of the San Jose Scale in Japan, as well as to collecting generally, it was especially important that most of the time be spent in horticultural districts. An examination of the wild lands of the Empire will reveal many species of Coccids not included in this collection.

In this paper are listed seventy-six species collected on this expedition, twenty of which are described as new, while three more are described as new varieties. These new species and varieties are described under the following names:—

Monophlebus corpulentus.
Sasakia quercus.
Kermes nakagawæ.
Kermes nawæ.
Eriococcus japonicus.
Rhizococcus onukii.
Dactylopius comstocki.
Dactylopius pini.
Dactylopius kraunhiæ.
Pulvinaria horii.
Pulvinaria oyamæ.

Pulvinaria hazeæ.
Lecanium takachihoi.
Aspidiotus cryptomeriæ.
Aspidiotus jordani.
Aspidiotus kelloggi.
Leucaspis bambusæ.
Chionaspis colemani.
Chionaspis hikosani.
Fiorinia fioriniæ var. *japonica.*
Mytilaspis pomorum var. *japonica.*
Mytilaspis euryæ.
Mytilaspis newsteadi var. *tokionis.*

In addition to the seventy-six species of the author's own collecting is appended a list of all other Coccidæ found recorded from Japan; this list includes forty species, making a total of one hundred and sixteen species so far found in Japan. Of these species, seventy-one (including the twenty species published in this paper) were originally described from Japanese specimens.

The references given with each species are to the original description of the species, and to its occurrence in Japan.

For courtesies extended, the thanks of the author are due Hon. Shiro Fujita and Mr. Tsuneaki Sako, of the Department of Agriculture and Commerce of Japan; to Director J. Sawano and Mr. Suguyo Hori of the Nishigahara Agricultural Experiment Station, Tokyo, for kindly allowing the use of the laboratory; and also to many others for assistance given.

This opportunity is also taken to express sincere thanks to Professor T. D. A. Cockerell of East Las Vegas, New Mexico, and to Mr. Alexander Craw, Quarantine Officer, State Board of Horticulture, San Francisco, for much valuable information concerning Japanese Coccids. To Dr. L. O. Howard and his assistants, Messrs. C. L. Marlatt, Theo. Pergande, and J. Kotinsky, of the Division of Entomology, U. S. Department of Agriculture, the author is under great obligations for assistance in the determination of material.

This paper was prepared in the Entomological Laboratory of Stanford University, under the direction of Professor V. L. Kellogg.

II. DESCRIPTIONS OF NEW SPECIES AND IDENTIFICATION OF OLD SPECIES.

Family COCCIDÆ.

Subfamily MONOPHLEBINÆ.

Genus **Monophlebus** *Leach.*

1. **Monophlebus burmeisteri** (?) *Westwood.*

Monophlebus burmeisteri WESTWOOD, Arcana Entom., 1841, 1, 22, 4. SIGNORET, Essai, 1875, p. 364. MASKELL, Trans. & Proc. New Zealand Inst., Vol. XXIX, 1896, p. 327.

Four specimens of this species were found by the author in Hikosan, Kiushiu. The name of the host is unknown. Previous to this A. Koebele had found it on *Pinus* sp., in Yokohama.

2. **Monophlebus corpulentus,** sp. nov.

PLATE VII, FIGS. 1-3.

Adult Female.—Color brownish, legs and antennæ black, thinly covered with a white cottony secretion which is thicker on the ventral aspect. Elliptical in form, thick, segments distinct. Size of the largest specimen 16 mm. long, 7 mm. wide. When examined with compound microscope the skin shows a dense pubescence of short and long hairs, and many round pits. Antennæ nine-segmented, 1.6 mm. long; formula, 9, 5, (1, 2, 4, 6, 3) (7, 8); each segment bearing several rather long hairs. The measurements of the antennal segments are as follows:—

	1	2	3	4	5	6	7	8	9
Length..	133	166	183	166	200	166	150	150	200
Width...	466	250	200	200	200	166	133	133	150

Rostral loop long; mentum conical, dimerous. Legs subequal, stout; anterior pair smaller than posterior pairs; coxa wider than long; trochanter triangular in shape; femur very thick, outer margin convex, shorter than tibia; tibia more than twice as long as tarsus; inner margin of tibia and tarsus bearing several strong spiny hairs; all segments with many hairs; claw large, with one to four spine-like digitules on its inner margin. Anal ring hairless.

Found by the author on the trunk of *Quercus* sp. in the grounds of Nishigahara Agricultural Experiment Station, Tokyo.

This species is related to *Monophlebus burmeisteri* Westwood, but may be readily distinguished from the latter by its great size, legs much thicker and stouter, femur comparatively short.

Type in the Entomological Collection of Leland Stanford Jr. University, and co-types in the author's collection.

Genus **Icerya** *Sign.*

3. **Icerya** sp.

Two specimens were obtained by the author in Mr. Yafune's orange orchard, Arita-gun, Yakayamaken. Not being in a good condition the species could not be determined.

Subfamily MARGARODINÆ.

Tribe *Xylococcini.*

Sasakia, gen. nov.

Adult female with nine-segmented antennæ; body distinctly segmented, mouth-parts wanting in the adult stage; no digitule on claw nor on tarsus; anal tube absent; enclosed in a cottony secretion.

Larva with six-segmented antennæ; anal tube wanting.

4. **Sasakia quercus,** sp. nov.

PLATE VII, FIGS. 4–8.

Adult Female.—The adult female is usually found in crevices on bark, in a white cottony secretion. Color red; antennæ and legs reddish brown. Length 1.85 mm., width about 1 mm.; subelliptical, narrower toward anterior. Antennæ close to each other, very stout, nine-segmented, constricted at base of each segment, about .5 mm. long; formula, 1, 9, (2, 3, 4, 5, 6, 7, 8); segment 1 very stout and long; segments 2 to 8 subequal; short hairs on each segment. Legs subequal, very stout; coxa stout, as wide as long.

trochanter large; femur very stout, outer margin very convex; tibia as long or longer than femur, with at least six knobbed hairs, and many spines at the posterior end; tarsus less than half as long as tibia; outer margin convex, inner margin concave, and bearing four or more spiny hairs; claw very stout and curved; no digitules on claw nor on tarsus; anal tube wanting. There are small round pits on the dorsum.

Intermediate Stage.—Length 1 mm., width .7 mm.; suboval, slightly narrower toward anterior; color red. Antennæ and legs wanting; mouth-parts prominent; rostral loop long.

Newly Hatched Larva.—Length about .2 to .25 mm.; elliptical in outline, narrower toward anterior end. Color red; antennæ and legs pale. Eyes round and prominent. Antennæ very large, club-shaped, and close together; six-segmented; formula 6, 1, 3, 4, 5, 2; segment 6 very much the longest, as long as all the others together; segment 1 next to the longest and very broad; segment 2 shortest; each bearing a few hairs. Mouth-parts very large; rostral loop long. Legs subequal; coxa wider than long; femur stout; tarsus short; digitules fine hairs; claw, long and slender. Posterior end of the body with two long hairs and a few very fine scattered hairs. Margin of body with capitate hairs. Anal tube wanting.

This species was found by the author on *Quercus myrsinæfolia* (Shira-gashi) and *Quercus acuta* (Katagi), in Tokyo, and on *Quercus acuta* in Chikujo-gun, Kiushiu.

"The absence of the anal tube in younger stages allies it with certain species of *Cœlostoma*" (Pergande).

Type in the Entomological Collection of Leland Stanford Jr. University, and co-types in the author's collection.

Subfamily COCCINÆ.

Tribe *Asterolecanium*.

Genus **Lecaniodiaspis** *Targ.*

5. **Lecaniodiaspis quercus** *Ckll.*

Lecaniodiaspis quercus COCKERELL, Psyche, Supp., 1896, p. 19; Bull. T. S. No. 4, Div. Ent., U. S. Dept. Agric., 1896, p. 51.

This species was found by the author on *Quercus acuta* (Katagi), *Pasarnia glabra* (Matera-shii), and *Q. sessilifolia* (Tsukubane-gashi) in Tokyo, and *Q. acuta* in Chikujo-gun, Kiushiu. It was originally described by Cockerell from specimens sent to the Division of Entomology, U. S. Department of Agriculture, by O. Takahashi, Tokyo.

Tribe *Kermesini.*

Genus **Kermes** *Boitard.*

6. **Kermes nakagawæ,** sp. nov.

PLATE VII, FIGS. 9–15.

Adult Female.—Length 4 to 5 mm., width 5 to 6 mm., height 3.5 to 4 mm. Color dark brown with black transverse markings; covered with waxy, grayish white secretion. A broad median longitudinal groove; in the groove near the base is a round protrusion which usually has a grayish white flake on each side. Antennæ very small, about .1 mm. long, three-segmented; formula 3, 2, 1; segment 3 much the longest, longer than 1 and 2 combined; last segment bearing four or five long hairs. Legs vestigial, only three parts being apparent; claw large, curved; one pair of digitules.

Newly Hatched Larva.—Length 4 mm., width .2 mm.; oval in shape. Color pinkish; antennæ and legs pale brown. Mouth-parts large, well-formed; rostral loop long. Antennæ short, only .1 mm. long, six-segmented; formula, 6 (3, 2, 1) (5, 4); segment 6 longest; 4 shortest; segment 1 stoutest. Legs short and stout; tibia and tarsus about equal in length; tarsal digitules fine and knobbed, digitules on claw short and stout; claw large, curved, and denticulate on its inner side. Margin of body with capitate hairs; two rows of capitate hairs on thoracic and abdominal segments. Ventral aspect with five rows of fine hairs. Caudal lobes terminated with a long hair; three spines behind the anal opening.

This species was found by the author on the trunk of *Quercus serrata* (Kunugi) in Akabane, *Quercus* sp. in the grounds of the Nishigahara Agricultural Experiment Station, Tokyo, and on *Q. glandulifera* (Nara) at Hikosan, Kiushiu. The scales are usually found in groups, and are badly infested by parasitic hymenoptera.

Type in the Entomological Collection of Leland Stanford Jr. University, and co-types in the author's collection.

7. **Kermes nawæ,** sp. nov.

PLATE VIII, FIGS. 16–22.

Adult Female.—Length about 6.5 mm,, width 7 mm., height nearly 5 mm., globose in outline. Color shining chestnut brown; dorsum with five black transverse markings; no longitudinal groove; thinly covered with white powder. When taken off, the specimens leave some of the white cottony substance on the tree. Antennæ and legs very small. Antennæ consist of five segments, .16 mm. long; formula, 3, 4, 5, 2, 1; segment 3 the longest; terminal segment bearing several rather long hairs; the others a few short ones. Mouth-parts well developed; mentum very large, conical, dimerous. Legs subequal; coxa stout, not very much shorter than femur; trochanter small, triangular, with two spines; tarsus longer than tibia; tarsal digitules fine and knobbed, digitules on claw short and stout; claw large, with a minute denticle on its inner margin.

Newly Hatched Larva.—Length .6 mm., width .3 mm.; elliptical in form; color pale brown. Antennæ and legs very large, well developed. Antennæ six-segmented; segment 6 the longest; segments 1 to 5 with a few hairs; segment 6 bearing many rather long hairs; formulæ:—

6, 1, 3, 2, (4, 5).
6, 3, (2, 1) 4, 5.
6, (1, 3) (2, 4, 5).
6, 3, 1, (2, 4, 5).
6, (3, 1) (4, 5) 2.

Mouth-parts very large; rostral loop longer than body; mentum large and conical. Margin of body with conspicuous, spiny hairs. Two capitate hairs on submargin close to first spiracle. Legs subequal; tibia about one-half as long as tarsus; four fine hair-like digitules; claw slender, denticle on its inner margin. Ventral aspect of body with transverse rows of fine hairs; posterior end of body furnished with lobes, each terminated by a long hair, and three spines, two on inner side of the hair and one on the outside. Anal ring hairless.

This species was found by Mr. Nawa on *Quercus glandulifera* (Nara) in Fukui-ken, and by Mr. A. Onuki, on *Rhamnus japonica* var. *genuina* (Kuro-umemodoki) in Nagano-ken.

Type in the Entomological Collection of Leland Stanford Jr. University, and co-types in the author's collection.

Tribe *Eriococcini.*

Genus **Eriococcus** *Targ.*

8. **Eriococcus graminis** (?) *Mask.*

Eriococcus graminis (?) MASKELL, Trans. & Proc. New Zealand Inst., Vol. XXX, 1897, p. 243.

This species was found on bamboo, in Gifu-ken. The original description was made by Maskell from specimens sent to him by A. Koebele, who had found them on grass in Hongkong.

9. **Eriococcus japonicus,** sp. nov.

PLATE VIII, FIGS. 23–25.

Adult Female.—Female sac, length about 1.7 mm., width about 1 mm.; convex, elliptical; color pale straw.

Female, length about .65 mm., width, .4 mm.; oval in outline, anterior end narrow, segments distinct. Antennæ five-segmented, about .1 mm. long; formula, 5, 3, 1, 2, 4; segment 5 longest; 4 shortest; segment 6 with many hairs; the others with few. Anterior pair of legs smaller than posterior pairs; coxa large; trochanter very small, bearing a long hair; femur stout, convex on both sides; tarsus longer than tibia; claw large, curved; digitules on tarsus long and fine, digitules on claw stout and short. Coxa of second and third pairs of legs very large, almost as long as femur. Margin of body with spines; each abdominal segment with a transverse row of strong spines; spines on thorax not in a row. Posterior end of body furnished with two lobes, each bearing a long hair and a few spines. Anal ring prominent, and bears six hairs.

Eggs.—Length .4 mm., width .25 mm.; elliptical; brown in color.

Male Cocoon.—Length .7 mm., width .3 mm.; elliptical; same color as the female sac.

This species was found by the author on *Symplocos myrtacea* (Hainoki) in Chikujo-gun, Kiushiu.

Type in the Entomological Collection of Leland Stanford Jr. University, and co-types in the author's collection.

10. **Eriococcus onukii**, sp. nov.

PLATE VIII, FIGS. 26–28; PLATE IX, FIGS. 29–33.

Adult Female.—Female sac, length about 3.5 mm., width 2 mm.; strongly convex, suboval in outline, usually with five transverse ridges on the dorsum, but sometimes only four. Color of the sac white inclining to grayish.

Female reddish brown. When boiled in KOH turns red; spread out under cover-glass measures 2.5 to 3 mm. in diameter; dorsum with strong spines, ventral aspect bearing many fine scattered hairs. Mouth-parts well formed, rostral loop short. Antennæ seven-segmented, .23 mm. long; segment 1 stout and shortest; segment 3 longest, but not much longer than 4; terminal segment with several long hairs, the others with a few short ones; formulæ:—

$$\left.\begin{array}{r} 3,\ 4,\ 7,\ 2\ (5,\ 6)\ 1 \\ (3,\ 4)\ 1,\ 7,\ 2,\ 6,\ 5 \end{array}\right\}\ \text{one specimen.}$$

$$\left.\begin{array}{r} (3,\ 4,\ 7)\ 2\ (5,\ 6)\ 1 \\ (3,\ 4)\ 7,\ 2\ (5,\ 6)\ 1 \end{array}\right\}\ \text{one specimen.}$$

$$\left.\begin{array}{r} (2,\ 3,\ 7)\ (4,\ 5)\ 6,\ 1 \\ 3,\ 7,\ 2,\ 4\ (5,\ 6)\ 1 \end{array}\right\}\ \text{one specimen.}$$

Legs as usual, subequal; coxa large, stout, longer than wide, bearing a few spines; trochanter rather large, subtriangular, with two long and one short spiny hair; tibia shorter than tarsus, with two spines on inner margin of posterior extremity; tarsus slightly tapering toward end; tarsal digitules long, knobbed, and hair-like, digitules on claw short, slightly extending beyond claw; claw large, well curved, with denticle on its inner margin. The posterior end of the body is furnished with lobes, each terminated by a long hair and a spine. Anal ring very prominent, with eight hairs.

Egg.—Length .3 mm., width .17 mm.; oval in shape; color pale brown.

Newly Hatched Larva.—Length .41 mm., width .2 mm.; long, elliptical in form, very much like that of *Gossyparia ulmi.* Antennæ six-segmented, .1 mm. long; formula, 3, 6, 2 (1, 4, 5); segment 3 longest; segment 1 stoutest; segment 6 with many long hairs; the others with a few. Mouth-parts large; rostral loop reaching to the fourth abdominal segment. Legs subequal, large; tibia very much stouter than tarsus; tarsal digitules fine and knobbed, digitules on claw short, extending only slightly beyond claw. Margin of body with very strong spines; dorsal aspect of thoracic, and first two abdominal segments, with two spines. Abdomen tapering toward posterior extremity, and furnished with lobes, each bearing long hairs and two spines. Anal ring with six hairs.

This species was found by the author on *Arundinaria hindsii* var. *graminæ* (Kanzanchiku) in the grounds of the Nishigahara Agricultural Experiment Station, Tokyo.

Type in the Entomological Collection of Leland Stanford Jr. University, and co-types in the author's collection.

Genus **Gossyparia.**

11. **Gossyparia ulmi** *Geoff.*

Gossyparia ulmi GEOFF. SIGNORET, Essai, 1875, p. 21. HOWARD, Insect Life, Vol. II, 1890, p. 34. COCKERELL, Proc. Phil. Acad., 1899, p. 268.
Gossyparia spuria MODEER.

This species was found by K. Oyama, on *Ulmus* sp., in Nagano-ken. It differs, however, from the specimens found on Stanford University campus in having the body of the adult female entirely covered by the waxy secretion. Microscopic characters show no difference.

Tribe *Dactylopiini.*

Genus **Dactylopius** *Costa.*

12. **Dactylopius comstocki,** sp. nov.

PLATE IX, FIGS. 34 AND 35.

Adult Female.—Length 4 mm., width 2 mm.; long oval in outline, slightly narrow in front. Dark purple in color; antennæ and legs brown; body dusted with white powder.

When boiled in KOH the color is purple. Antennæ eight-segmented, .5 mm. long; segment 8 longest; 3 next in length, but not much longer than 2; segment 8 bearing many hairs; the others a few; formulæ:—

8, 3, 1, 2, 5, 6, 7, 4.
8 (3, 2) 1, 7, 5, 6, 4.
8, 2 (3, 1) 5, 4, 7, 6.
8 (2, 3) 1, 5, 4, 6, 7.
8 (2, 3, 1) 5, 6, 4, 7.
8 (2, 1) 3, 5, 4 (6, 7).

The measurements of the antennal segments vary as follows:—

	1	2	3	4	5	6	7	8
1	47	53	50	27	33	36	36	94
2	41	53	47	22	25	27	33	91
3	44	66	55	36	41	41	44	108
4	44	55	53	39	39	39	44	111
Ave.	44	56	51	31	34	34	39	101

Mouth-parts large; rostral loop long. Spiracles large. Legs normal; coxa longer than wide, with several spines; trochanter as usual, bearing one long and a few short hairs; femur thick, outer margin convex, with many scattered hairs; tibia as long as femur, tapering posteriorly, with many hairs; tarsus about one-third as long as tibia, tapering posteriorly, with many hairs; tarsal digitules fine and knobbed, digitules on claw short, gradually widening into large knobs. Dorsum with fine scattered hairs and round pits. Posterior end of body furnished with lobes, each bearing a fine long hair and two stout spines. Anal ring round, prominent, with six hairs.

Found at Akabane by the author in cracks or crevices of trunk of mulberry-tree (Kuwa), near the ground, and protected by a covering made by ants. The ants and scales associate in the chamber, being mutually benefited. It was also found in the crevices of the trunk of a kind of maple in the grounds of the Nishigahara Agricultural Experiment Station, Tokyo.

This species is related to *Dactylopius theobromæ* Dougl. The two species may be separated by the following table:—

Dactylopius comstocki.	*Dactylopius theobromæ.*
Segment 8 of antenna very much shorter than 5, 6, and 7 together.	Segment 8 of antenna equal to 5, 6, and 7 together.
Tarsi one-third length of tibiæ; claw rather long and large.	Tarsi half the length of tibiæ; claw short.

Type in the Entomological Collection of Leland Stanford Jr. University, and co-types in the author's collection.

13. Dactylopius pini, sp. nov.

PLATE IX, FIGS. 36–38.

Adult Female.—Found among growing needles of pine. A white cottony secretion covers all the body. Color, reddish brown; legs and antennæ brown. When boiled in KOH the color turns purple. Length about 4 mm., width about half the length. Margin of body with fine simple hairs; dorsum with fine hairs and minute round pits. Antennæ eight-segmented, .4 to .5 mm. long, hairy; segment 8 always longest; 4 usually shortest; segments 2 and 3 subequal. The following formulæ show the variations in the relative lengths of the antennal segments:—

8, 2, 3, 1 (6, 7) 5, 4.
8, 2, 3, 1, 7, 6, 5, 4.
8, 2, 3 (1, 7) (5, 6) 4.
8, 2, 3 (1, 7) (4, 5, 6).

The measurements of the antennal segments vary as follows:—

	1	2	3	4	5	6	7	8
1	83	75	88	47	55	53	50	111
2	80	83	83	47	55	47	53	108
3	72	77	72	53	58	44	47	111
4	77	80	80	53	64	50	47	116
5	75	75	75	47	55	50	41	105
6	77	77	72	53	64	44	44	111
Ave.	77	77	78	50	58	45	47	110

Mouth-parts as usual; rostral loop long. Legs round; coxa short, wider than long; trochanter triangular, with one long and two or more short hairs; femur large, outer margin convex; tibia not so stout as femur, but almost equal to it in length; tarsus less than half the length of tibia; segments with many projecting hairs; tarsal digitules long, fine, knobbed, and hair-like; digitules on claw quite stout and short, extending a little beyond claw; claw thick, curved. Anal ring round, prominent, with six hairs. Caudal hairs short, with two strong spines.

Newly Hatched Larva.—Larva taken from the female is oval in shape; length about .35 mm., half as wide as long. Antennæ five-segmented, about ⅓ mm. long; formula, 5, 3, 2, 1, 4; segment 5 longest; 4 shortest; terminal segment with many prominent hairs; others with comparatively few. Margin of body with fine simple hairs. Legs large and subequal. Posterior end of body furnished with prominent lobes, each bearing a long hair with two stout spines at the base. Anal ring distinct, with six hairs.

Found by the author on *Pinus* sp. in Koishiwara, Kiushiu, and on *Pinus pentaphylla* (Goyo-matsu) in the grounds of the Nishigahara Agricultural Experiment Station, Tokyo.

This new species is closely allied to *Dactylopius sequoiæ* Coleman, but they may be separated by the following table:—

Dactylopius pini.	*Dactylopius sequoiæ.*
Female enclosed in a sac.	Female not enclosed in a sac.
Female with no egg-sac on the caudal ventral aspect.	Female with egg-sac on the caudal ventral aspect.
Female gives birth to young.	Female lays eggs.
Antennæ of young five-segmented.	Antennæ of young six-segmented.

Type in the Entomological Collection of Leland Stanford Jr. University, and co-types in the author's collection.

14. **Dactylopius kraunhiæ,** sp. nov.

PLATE IX, FIGS. 39 AND 40.

Adult Female.—Enclosed in a cottony sac, of irregular shape; color reddish brown. When boiled in KOH and spread out under cover-glass measures about 2 mm. in length and 1.5 mm. in width; broad elliptical in form. A transverse row of spines on the dorsal aspect of each segment; ventral aspect with fine hairs; dorsum covered with small round pits. Antennæ and legs large, brown in color. Antennæ eight-segmented, .5 mm. long, hairy; formula, 8, 3, 2, 1, 5 (4, 6, 7); the measurements of each antennal segment, (1) 69–69; (2) 77–80; (3) 83; (4) 55; (5) 56; (6) 53; (7) 55; (8) 111; segment 6 slightly longer than 3; segment 3 slightly longer than 2; segments 4, 5, 6 and 7 subequal; segment 1 stoutest. Mouth-parts comparatively large; rostral loop long, extending down to the first or second abdominal segment. Legs subequal, hairy; coxa much wider than long; trochanter as usual, bearing a few spiny hairs; femur thick, outer margin convex; tibia slightly shorter than femur and three times as long as tarsus; tarsal digitules fine and knobbed, digitules on claw stout, short, and knobbed; claw as usual, curved. Each of the marginal lobes of the posterior segment bears a single long hair, with two spines at the base. Anal ring large, prominent, with six hairs.

This species was found by the author on *Kraunhia floribunda* (Fuji) at the Yokohama Nursery, Yokohama.

This is allied to *D. pini* Kuwana, but the body of the former is shorter and more stout, the legs and antennæ larger in proportion to the body, and segment 8 of the antenna is as long or not quite so long as 6 and 7 together, while 6 is not much longer than 3.

Type in the Entomological Collection of Leland Stanford Jr. University, and co-types in the author's collection.

Genus **Phenacoccus** *Ckll.*

15. **Phenacoccus pergandei** (?) *Ckll.*

Phenacoccus pergandei COCKERELL, Bull. No. 4, T. S., Div. Ent., U. S. Dept. Agric., 1896, p. 55.

This species was found by the author on *Diospyros kaki* (Kaki) in Kusatsu, Shiga-ken. The specimens are in a poor condition.

Genus **Sphærococcus** *Mask.*

16. **Sphærococcus parvus** *Mask.*

PLATE IX, FIG. 41.

Sphærococcus parvus MASKELL, Ent. Mon. Mag., Vol. XXX, 1897, p. 244; Trans. & Proc. New Zealand Inst., Vol. XXX, 1897, p. 247.

This species was found by the author on the trunk of a cherry-tree in the grounds of the Nishigahara Agricultural Experiment Station, Tokyo. Previous to this it had been found for the first time by A. Koebele, on a cherry-tree in Japan (the locality not mentioned), and described by Maskell as a new species.

Mr. Maskell evidently made a mistake when he considered the antennæ of the newly hatched larvæ to be composed of six confused segments. They are distinctly three-segmented[1], about .23 mm. long; formula, 3, 1, 2. Anal ring of larva with six hairs. Antennæ of female appear to be two-segmented. Maskell's statement in regard to the anal ring being without bristles is erroneous. There are six small bristles or hairs.

Genus **Antonina** *Sign.*

17. **Antonina crawi** *Ckll.*

Antonina crawi COCKERELL, Psyche, Vol. IX, 1900, p. 71.

Newly Hatched Larva.—Length .4 mm., width .2 mm.; oval in shape; purple in color. Antennæ six-segmented, about .14 mm. long; formula, 6 (5, 4, 2) (1, 3); segment 6 much the longest; 2, 4 and 5 subequal; 3 shortest; segment 6 with many long hairs. Three pairs of legs subequal; tibia shorter than tarsus; claw slender and rather long; four digitules, lower pairs very stout. The dorsum covered with small round pits. Caudal end of abdomen bears two long hairs. Anal ring prominent, with six hairs.

This species was found by the author at the sheathing bases of leaves of different kinds of bamboo, in different places in Japan: on *Phyllostachys nigra* (Kuro-chiku), *Phyllostachys quilioi* (Madake), and on *Arundinaria simoni* (Narihira-dake) in the grounds of the Nishigahara Agricultural Experiment Station, Tokyo, on Madake in Akabane, and on many kinds of bamboo in Kiushiu. Sometime before this it had been found on bamboo from Japan by A. Craw, in quarantine work at San Francisco.

Genus **Pseudolecanium** *Ckll.*

18. **Pseudolecanium tokionis** *Ckll.*

Pseudolecanium tokionis COCKERELL, Psyche, Supp., 1896, p. 16; Bull., No. 4, T. S., Div. Ent., U. S. Dept. Agric., 1896, p. 49; Psyche, Vol. IX, 1900, p. 71. KUWANA, Proc. Cal. Acad. Sci., 3d Ser., (Zool.) Vol. II, 1901, p. 403.

This species was found by the author on bamboo in the vicinity of Tokyo, and on the same host in Gifu-ken. It was originally described by Cockerell from dry specimens sent to the Division of Entomology, U. S. Department of Agriculture, by O. Takahashi, Tokyo. In 1899 the author found it on bamboo on the Stanford University campus, and the male in different stages was described by him.

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[1] Mr. Pergande, who examined the author's specimen, says the antennæ consist of four segments.

Subfamily LECANIINÆ.

SERIES I.

Genus **Pulvinaria** *Targ.*

19. **Pulvinaria psidii** *Mask.*

PLATE X, FIG. 42.

Pulvinaria psidii MASKELL, Ent. Mo. Mag., Vol. XXXIII, 1897, p. 243; Trans. & Proc. New Zealand Inst., Vol. XXX, 1897, p. 242.

This species was found by the author on *Diospyros kaki*, in Gifu-ken, on Tsuta in Hikosan, Kiushiu. A. Koebele had also found it on *Citrus*, *Pittosporum* and *Eurya japonica*, in Japan.

20. **Pulvinaria aurantii** *Ckll.*

PLATE X, FIG. 43.

Pulvinaria aurantii COCKERELL, Psyche, Supp., 1896, p. 19; Bull., No. 4, T. S., Div. Ent., U. S. Dept. Agric., 1896, p. 48.

Newly Hatched Larva.—Length .4 mm., width .21 mm.; suboval; abdominal cleft distinct. Rostral loop long. Antennæ and legs large, well developed. Antennæ six-segmented; formula, (6, 3) 1, 2, 4, 5. Three pairs of legs subequal; tibia and tarsus about equal in length. Margin of body with fine simple hairs. Anal plates conspicuous, each with a very long hair.

This species is one of the worst pests in the orange orchards. It occurs in almost every part of the Empire. The author collected it in the following places: on orange in Kokura, Chikujo-gun, Kato-mura, and Hukuoka City, in Kiushiu, and in Wakayama-ken, Kiyoto, Osaka, Gifu-ken, Aichi-ken, Tokyo, and Yokohama, in Hondo. It was also found on *Eurya ochnacea* (Sakaki), in Chikujo-gun, Kiushiu, and on tea-plant in the grounds of the Nishigahara Agricultural Experiment Station, Tokyo.

21. **Pulvinaria horii,** sp. nov.

PLATE X, FIGS. 44–52.

Adult Female.—Found usually in crevices of bark or in any sheltered place on trunk and large limbs, singly and in clusters. Color pale brown. The scale is circular, with many short lines radiating from the margin toward the center; in the center two longitudinal lines are bordered by two transverse lines, forming a quadrangle with a much raised longitudinal median line. The scale is not covered with secretion. Ovisac snow white, its base ranging from 4 to 5 mm.; ovisac extending posteriorly and laterally, with many distinct, radiating grooves, as shown in the figure; the posterior end of scale distinctly cleft. When boiled in KOH and spread out under a cover-glass measures about 8 mm.; circular in outline; abdominal cleft deep. Antennæ eight-segmented, .41 mm. long; formula 2 (3, 4, 5) 6, 7, 8, 1; segment 2 longest; 3, 4, and 5 subequal and next in length; segment 1 stoutest and shortest; segment 8 with many long hairs; the others with few. Mouth-parts small; rostral loop short. Margin of body with fine simple hairs; each anterior incision has a long spine with a short one on each side. Legs subequal; coxa longer than wide, with two or more spines; trochanter the usual shape but small, with one long and a few short hairs; femur, the longest segment of the leg, is as wide as coxa and bears a few spines; tibia slender, almost as long as femur; tarsus less than half the length of tibia, with four digitules and a terminal claw; tarsal digitules fine and knobbed, digitules on claw stout and knobbed; claw large and curved. Triangular plates small but conspicuous, several spiny hairs along posterior portions. Anal ring large, bearing many (eight ?) long hairs.

Newly Hatched Larva.—Length .66 mm., width .4 mm.; broadly elliptical, front rounded, widest in thoracic regions. Color reddish brown; legs and antennæ pale brown. Eyes red and distinct. Margin of body with fine simple hairs, rather far apart; in each anterior incision is a long spine with a short one on each side. Mouth-parts large; rostral loop extending to about the third abdominal segment. Antennæ and legs large. Antennæ usually seven-segmented, .2 mm. long, hairy. The proportional lengths of antennal segments are variable even in the same specimen, but segment 3 is always the longest. The following formulæ show the variations:—

3, 7 (2, 6) 5, 4, 1.
3, 7, 2, 4, 5, 6, 1.
3, 6, 4, 5, 2, 1.
3, 6 (4, 5) 2, 1.
3, 4, 7, 5, 2, 6, 1.
3 (4, 5) 6, 2, 1.
3, 8, 2, 5 (4, 6, 7) 1.

Three pairs of legs subequal, anterior pair slightly smaller than the posterior pairs; coxa quite large, longer than wide, with a few hairs; trochanter small and triangular, with one long and a few short hairs; femur the largest segment of leg, and as wide as coxa; tibia shorter than femur, with a few spiny hairs along outer margin; tarsus much shorter than tibia, tapering posteriorly, and furnished with spiny hairs on outer margin; four digitules and a large curved claw at posterior extremity; tarsal digitules fine and knobbed. Caudal end of the body deeply cleft; triangular plates very large, with a long hair and a few fine spines at their posterior margins. Anal ring prominent, with six long hairs.

This species was found by the author on the trunks of *Acer trifidum* (To-kæde), *Æsculus turbinata* (Tochino-ki), and *Kœlreuteria paniculata* (Mokugenji), in the grounds of the Nishigahara Agricultural Experiment Station, Tokyo; it is named in honor of S. Hori, Entomologist of the Station.

Type in the Entomological Collection of Leland Stanford Jr. University, and co-types in the author's collection.

22. **Pulvinaria oyamæ**, sp. nov.

PLATE XI, FIGS. 53-56.

Adult Female.—A cottony mass suboval in form, there being at the narrower end a dark brown scale sometimes flattened, and sometimes bent upward at about its middle to nearly a right angle; oval, slightly broader behind, where it is notched and apparently cleft for a short distance in the middle. Dorsum with five or six transverse wrinkles or folds, and many raised lines running outwardly on each side to the posterior margin. Length of sac 6 mm., width about 4 to 5 mm., snow white, no distinct groove; scale dark brown.

When boiled in KOH and spread out under cover-glass, measures about 5 to 7 mm. in length and 4 to 5 mm. in width. Mouth-parts well chitinized but small; rostral loop short. Antennæ usually 8-segmented, terminal segment bearing many long hairs, the others a few; relative lengths of antennal segments are variable, but segment 3 is longest, as may be seen in the following formulæ:—

3, 5, 2, 4, 1 (6, 7, 8).
(3, 2, 4) 5, 6, 8, 7, 1.
(3, 4) 2, 5 (6, 7, 8) 1.

Legs subequal; coxa stout, longer than wide, with a few long spiny hairs; trochanter as usual, with one long hair; femur stout, with a few scattered hairs; tibia shorter and smaller than femur, with several long hairs on the inner margin and weak hairs on the outer margin; tarsus one-half as long as tibia, with spiny hairs; tarsal digitules long, fine, and knobbed, digitules of claw very stout, gradually widening to large knobs; claw large and curved. Margin of body with spiny hairs, in each anterior incision is one large spine with a short one on each side. Anal plates as usual, posterior extremity rounded, with a few long hairs. Anal ring with eight prominent hairs.

This species was collected by K. Oyama, in Nagano-ken. The host is unknown.

Type in the Entomological Collection of Leland Stanford Jr. University, and co-types in the author's collection.

23. **Pulvinaria hazeæ**, sp. nov.

PLATE XI, FIGS. 57-59.

Adult Female.—Length with ovisac about 37 mm., width 5 mm.; ovisac white, without groove (the scales having been long exposed to weather the ovisacs were in so poor a condition that the texture could not be determined); scale, diameter 4.5 mm.; subcircular in outline; light brown in color.

When boiled in KOH and spread out under cover-glass, diameter about 6 mm. Antennæ eight-segmented, about .56 mm. long; formula, 3, 4, 2, 5, 8 (6, 7) 1; segment 3 much the longest; segment 1 stoutest and wider than long; the last segment bearing many long hairs. Mouth-parts small but well formed; rostral loop short. Anterior pair of legs smaller than the posterior pairs; coxa stout, longer than wide; trochanter the usual triangular shape, with one long spiny hair; femur large and as broad as coxa; tibia shorter than femur, with many long hairs; tarsus about one-third as long as tibia, with several spiny hairs; tarsal digitules long and knobbed, digitules of claw stout, gradually widening to large knobs; claw stout and curved. Margin of body with fine simple hairs; in each anterior incision is one large spine, with a short one on each side. Anal plates distinct, yellowish brown, with three or more rather long spiny hairs near posterior margins. Anal ring with six hairs.

Egg.—Length .3 mm., width .2 mm.; oval in shape; color brown.

This species was found by the author on the trunk of *Rhus succedanæ* (Haze-no-ki) in Koishiwara, Chikujo-gun, Kiushiu.

Type in the Entomological Collection of Leland Stanford Jr. University, and co-types in the author's collection.

Genus **Takahashia** *Ckll.*

24. **Takahashia japonica** *Ckll.*

Takahashia japonica COCKERELL, Psyche, Supp., 1896, p. 20; Bull. No. 4, T. S., Div. Ent., U. S. Dept. Agric., 1896, p. 47.

Egg.—Length .5 mm., width .3 mm.; elliptical in form; color pinkish brown.

Newly Hatched Larva.—Length .8 mm., width .35 mm.; elliptical in form; color brown; abdominal cleft distinct; margin of body with spiny hairs; anterior marginal incision with three subequal spines. Mouth-parts large; rostral loop reaching to about the third abdominal segment. Antennæ six-segmented; formula (6, 3, 5) (1, 2, 3). Legs rather large. Anal plates large, each bearing a long hair.

This species was found by the author on the mulberry-tree in Hukuoka, Gifu, Tokyo, and Sendai, and on other plants in Gifu and Saitama-ken.

SERIES II.

Genus **Ericerus** *Guer.*

25. **Ericerus pela** *West.*

Ericerus pela WEST, C. R. tome X, pp. 618-666; Revue Zoologique de Guerin-Meneville, 1830, p. 120; Gardeners' Chronicle, London, 1853, p. 532. SIGNORET, Essai, 1874, pp. 91, 92. SASAKI, Zool. Mag., Tokyo, Japan, No. 114, pp. 111-116. (In Japanese.)

This interesting insect has been known in certain parts of the Empire for years as producing wax. It is known to the people by the name of Ibota-mushi, because of its feeding on *Ligustrum ibota* or Ibota-no-ki. According to C. Sasaki, it has been recorded from Hukushima, Tottori, Nagano and Kochi-ken.

The author's specimens (male) were obtained from Y. Nawa, Gifu.

Genus **Ceroplastes** *Gray.*

26. **Ceroplastes floridensis** *Comstock.*

Ceroplastes floridensis COMSTOCK, Ent. Rept. U. S. Dept. Agric., 1880, p. 331.

This species was found by the author on oleander, in Wakayama-ken, and on the tea-plant in Tokyo and Yokohama. This is the first time it has been recorded from Japan.

27. **Ceroplastes ceriferus** *And.*

Ceroplastes ceriferus AND. MASKELL, Trans. & Proc. New Zealand Inst., Vol. XXV, 1892, p. 216. CRAW, Rept. Calif. State Bd. Hort., 1895-96, p. 44.

This species was found by the author on *Taonobo japonica*, (Mokkoku), in Minoshima, Wakayama-ken, and on the tea-plant in Kokura, Kiushiu. It is one of the worst tea-plant pests. In a plantation near Kokura the trees were badly infested by this pest. Mr. Alexander Craw, San Francisco, found this insect on camellia, gardenia, and orange-trees from Japan.

SERIES III.

Genus **Lecanium** *Illig.*

28. **Lecanium (Saissetia) hemisphæricum** *Targ.*

Lecanium hemisphæricum TARG. COMSTOCK, Ent. Rept. U. S. Dept. Agric., 1880, p. 334.

This species was found by the author on *Phajus grandiflorus* (Kwaku-ran) and *Gardenia florida* (Kuchinashi) in the grounds of the Yokohama Nursery, Yokohama, and on *Schinus molle* and *Asparagus plumosus* in a green-house in Shinjiku, Tokyo. The insect was not found in the native woods. This is the first time it has been recorded from Japan.

29. **Lecanium (Eulecanium) takachihoi,** sp. nov.

PLATE XI, FIGS. 60–64.

Adult Female.—Length 6.5 mm., width 4 mm., height 4 mm., convex; dark brown in color; suboval, longitudinal carina distinct, anterior half of the scale much enlarged, gradually tapering posteriorly. Abdominal cleft distinct. The dorsum with irregular pits.

Under the compound microscope the skin shows hexagonal markings, and round, scattered, transparent pits. Antennæ seven-segmented, .5 mm. long; formula, 3, 4, 7, 6, 5, 2, 1; segment 3 not much longer than 4; segments 5 and 6 subequal; segment 1 shortest and stoutest; segments 1 to 6 with a few hairs; 7 with many long ones. Legs well developed; coxa longer than wide; trochanter as usual, with two hairs; femur convex on both sides, with two hairs on outer margin near posterior extremity; tibia a little longer than tarsus, with two hairs on inner margin near posterior extremity and one hair on the outer margin opposite the two; tarsus tapering posteriorly, and finished with a curved claw; tarsal digitules long and knobbed, digitules on claw short and stout. Anal plates rather small, with one or two spiny hairs at the posterior margin.

Newly Hatched Larva.—Length .58 mm., width .27 mm.; oval in shape; pinkish in color. Antennæ six-segmented, barely .2 mm. long; formula, 3, 6, 5, 1 (2, 4); segment 3 much the longest; segment 6 with many long hairs. Mouth-parts large; rostral loop reaching to about the third abdominal segment. Legs large; coxa stout and long; tarsus much shorter than tibia; tarsal digitules long, fine, and knobbed; digitules on claw short, small, and knobbed. One long and a few short hairs on the posterior end of each anal plate. Anal opening conspicuous, with six hairs.

This species was found by the author on a chestnut-tree, in Hikosan, Kiushiu, and is named in honor of N. Takachiho.

This scale is allied to *Lecanium pruinosum*, but is not covered with white powder.

Type in the Entomological Collection of Leland Stanford Jr. University, and co-types in the author's collection.

30. **Lecanium rotundum** (?) *Réaumur.*

Lecanium rotundum (?) RÉAUMUR. SIGNORET, Essai, 1873, p. 428.

Two specimens were found by the author on the prune-tree, in Shinjiku, Tokyo.

31. **Lecanium (Calymnalus) hesperidum** *L.*

Lecanium (Calymnalus) hesperidum L. COMSTOCK, Ent. Rept. U. S. Dept. Agric., 1880, p. 335.

This species is a common green-house pest in Japan. The author found it on *Abutilon* sp., *Nerium odorum* (Kyochikuto), *Jasminum* sp., *Cycas revoluta* (Sotetsu), and *Eriobotrya japonica* (Biwa), in the green-house of the Agricultural College, Sapporo, Hokkaido, and on *Cercis chinensis* (Hana-zuo), in the grounds of the Nishigahara Agricultural Experiment Station, Tokyo. The scales are commonly infested by parasitic hymenoptera. This is the first time it has been recorded from Japan.

32. **Lecanium (Saissetia) oleæ** *Bernard.*

Lecanium (Saissetia) oleæ BERNARD. COMSTOCK, Ent. Rept., U. S. Dept. Agric., 1880, p. 236; Bull. No. 4, T. S., Div. Ent., U. S. Dept. Agric., 1896, p. 40.

This species was found by the author on a lime-tree, in Kawasaki, near Tokyo. It is not at all common in Japan, in fact, it was not found in any other part of the Empire. A. Craw, in quarantine work, found it on deciduous magnolia from Japan some years ago.

33. **Lecanium**, sp.

PLATE XI, FIG. 65.

Of this scale but three female specimens were secured; one being infested by the hymenopterous parasites and another badly broken. The species could not be identified. Only the external characters will be given.

Female Scale.—Length 9 mm., width 9.5 mm., height 7.5 mm.; color dark shining brown, derm apparently thick; covered with white powder. Four raised cones on the dorsum. The scale, sloping toward the anterior end, has many raised, rather smooth ridges. The median groove distinct. The anal cleft deep.

This species was found by the author on *Kraunhia floribunda* (Fuji) in the grounds of the Yokohama Nursery, Yokohama.

Subfamily DIASPINÆ.

Genus **Aspidiotus** *Bouché.*

34. **Aspidiotus inusitatus** *Green.*

Aspidiotus inusitatus GREEN, Coccidæ of Ceylon, p. 49.

This species was found by the author on bamboo in Kokura, Kiushiu. This is the first time it has been recorded from Japan.

35. **Aspidiotus persearum** *Ckll.*

Aspidiotus persearum COCKERELL, Entomologist, 1898, p. 240. CRAW, Rept. Calif. State Bd. Hort., 1897–98, p. 108.

This species was found by the author on *Trachycarpus excelsus* (Shuro) in Tarumi, Chikujo-gun, Kiushiu. Previous to this A. Craw found it in his quarantine work at San Francisco, on "Alligator pears" *(Persea gratissima)* from Honolulu, H. I. This is the first time it has been recorded from Japan.

36. **Aspidiotus secretus** *Ckll.* var. **lobulatus** *Mask.*

Aspidiotus secretus var. *lobulatus* MASKELL, Ent. Mon. Mag., Vol. XXXIII, 1897, p. 241; Proc. & Trans. New Zealand Inst., Vol. XXX, 1897, p. 224.

This species was found by the author on many kinds of bamboo in the grounds of the Nishigahara Agricultural Experiment Station, Tokyo and Akabane. It has been recorded on *Bambusa* sp., (Miyanoshita) Japan, by A. Koebele.

37. **Aspidiotus trilobitiformis** (?) *Green.*

Aspidiotus trilobitiformis GREEN, Indian Mus. Notes, IV, p. 4.

This species was found by the author in a garden in Minoshima, Wakayama-ken. The name of the host is unknown. This is the first time it has been recorded from Japan.

38. **Aspidiotus duplex** *Ckll.*

Aspidiotus duplex COCKERELL, Psyche, Supp., 1896, p. 20; Bull. No. 4, T. S., Div. Ent., U. S. Dept. Agric., 1896, p. 52; Bull. No. 6, T. S., Div. Ent., U. S. Dept. Agric., 1897, p. 20. CRAW, Rept. Calif. State Bd. Hort., 1895–96, p. 33.

This species was found by the author on *Rhus succidanea* (Haze-no-ki) in Yukubashi, Kiushiu, on *Eurya ochnacea* (Sakaki) in the grounds of the Nishigahara Agricultural Experiment Station, Tokyo, and on *Thea japonica* (Tsubaki) in Yokohama. Originally described by Cockerell, from specimens sent to the Division of Entomology, U. S. Department of Agriculture, by O. Takabashi, Tokyo. A. Craw, San Francisco, also found this insect on the following plants from Japan: orange, camellia, azalea *Olea fragrans*, tea-plant, camphor, pæony, *Myrica rubra*, and rhododendron.

39. **Aspidiotus duplex** var. **pæoniæ** *Ckll.*

Aspidiotus duplex var. *pæoniæ* COCKERELL, Can. Ent., Vol. XXXI, 1899, p. 105.

This species appears to be a general feeder. It was found upon the following trees and plants: *Eurya ochnacea* in Hikosan; *Thea japonica* in Akabane; *Rhododendron indicum* var. *kæmpferi* (Tsutsuji); *R. indicum* var. *macranthum* (Satsuki); *Ilex latifolia* (Taraya); *Clethra barbineros* (Ryobu); and *Thea sinensis* (Cha) in Tokyo. A. Craw, San Francisco, had previously recorded it on a pæony from Japan.

This scale is one of the worst pests of tea and ornamental plants. In many places the tea-plants were dying from the effects of the pest.

40. **Aspidiotus perniciosus** *Comst.*

Aspidiotus perniciosus COMSTOCK, Ent. Rept. U. S. Dept. Agric., 1880, p. 304. KUWANA, Cont. to Biol., The Hopkins Seaside Lab. of Leland Stanford Jr. Univ., No. XXV, 1901, pp. 1-14. SASAKI, Annot. Zool. Japan, Vol. III, 1901, pp. 165-173.

This scale was recorded by the author from many localities on the three main islands of the Japanese Empire: Kiushiu, Hondo and Hokkaido. On Kiushiu Island it was found on an old native pear-tree (about fifty years old), which was badly infested with the scale. The tree was standing alone at the back of a farm house, with no possible chance of its having come in contact with an infected tree. On the same island, near Kokura, was a pear orchard about five years old. The stock came from Tokyo, and was badly infested with the scale. In the spring of 1899 the owner dug up and burnt more than three hundred trees, but it was too late then, for the scale had already spread nearly all over the orchard. In Shiga-ken it was found on pear, apple, and quince trees in the grounds of the Agricultural Experiment Station. In Gifu-ken there are many small orchards, in every one of which the scale was found. In Tokyo it was found on pear-trees in the Mita Nursery and other places, on pear-trees in Kawasaki, and in Yokohama on pear-trees growing in a pot. In the northern part of Hondo the scale was found in orchards in Angio, Sendai, Morioka, Aomori, and Hirosaki; and in Hokkaido it was found in the apple orchard of the Agricultural College, Sapporo. Many of the trees were dying from the attack of the scale. Since the author's return from Japan, Suguya Hori has written, saying that the scale has been found by him in some places in Hokurikudo. M. Nawa has also informed the author that he found it on nursery stock in Shikoku.

The scale was found upon the following hosts: pear, apple, peach, Japanese quince, currant, willow *(Salix gracilistyla)*, *Pilea pumila*, *Pæonia moutan.*

The detailed data of this species are given in the author's report on "The San Jose Scale in Japan" (Contrib. to Biol. from the Hopkins Seaside Laboratory of Leland Stanford Jr. University, No. XXV, p. 1–14, 1901.).

41. Aspidiotus ulmi *Johns.*

Aspidiotus ulmi Johnson, Bull. Ill. State Lab. Nat. Hist., Vol. IV, 1896, p. 388; Entomological News, Vol. VIII, 1896, p. 152.

This species was found by the author on *Cycas revoluta*, in the grounds of the capitol of Hukuoka, and on two unknown hosts, one in Akabane and the other in the Nishigahara, Tokyo. This is the first time it has been recorded from Japan.

42. Aspidiotus cydoniæ *Comst.*

Aspidiotus cydoniæ Comstock, Ent. Rept., U. S. Dept. Agric., 1880, p. 295.

This species was found by the author on fern (Kenchiyo) in the Yokohama Nursery, Yokohama. This is the first time it has been recorded from Japan.

43. Aspidiotus lataniæ *Sign.*

Aspidiotus lataniæ Signoret, Essai, 1868, p. 124.

This species was found by the author on *Abies firma* (Momi) in the grounds of the Nishigahara Agricultural Experiment Station, Tokyo. Previous to this it had been found on tea-plant in Gifu, but this is the first time it has been recorded from Japan.

44. **Aspidiotus cryptomeriæ**, sp. nov.

PLATE XII, FIGS. 66–68.

Scale of Female.—The scale of the female is usually elliptical, flatly convex. Length 1.1 to 2. mm., width about 1. mm.; usual color grayish, subtransparent. The exuviæ are usually a little to one side of the center; straw color. The first skin usually shows the segmentation distinctly, length about .4 mm.; the second skin is more or less covered with secretion, length about .65 mm. Ventral scale a mere film applied to bark of plant.

Female.—The body of the mature female is rather flat, pale yellow, and oval in shape. The last segment is a little deeper yellow than the rest of the body, and presents the following characters:—

There are five groups of spinnerets. The anterior group contains four to five; the anterior lateral, seven to eight; the posterior laterals four to six. There are three pairs of well developed lobes. The first and second lobes of lateral side are abruptly narrowed toward their posterior extremities from about one-half their length; the third pair is much smaller than the first two pairs, and the lateral sides are sloping and very minutely serratulate. The plates are well developed; they are not much longer than the lobes, and are fringed; there are two small ones between the median lobes; those of each side are as follows,—two between the first and second lobes, three between second and third lobes, usually seven laterad of the third lobe. The spines are prominent; the first pair is situated near the lateral margin of the base of the first lobes, the second and third, about the middle of the bases of the second and third lobes; two or more spines laterad of the base of the third lobe.

Scale of Male.—The scale of the male is elongated, with the larval skin nearly central; color grayish, same as female in texture; larval skin straw color. Length about 1. mm., width .6 mm.

This species was found by the author on *Cryptomeria japonica* (Sugi) in Gifu-ken. It is allied to *Aspidiotus destructor* Sign., but the female scale of the new species is elliptical in form, and the exuviæ in one side of the center, and the third pair of lobes of last abdominal segment of female is much smaller.

Type in the Entomological Collection of Leland Stanford Jr. University, and co-types in the author's collection.

45. **Aspidiotus jordani**, sp. nov.

PLATE XII, FIGS. 69–71.

Scale of Female.—The scale of the female is circular and flat; about 1.5 to 2.5 mm. in diameter. The general color of the scale is dingy brown, conforming usually to the color of the under side of the leaves to which it is attached. The exuviæ are in the center, and are covered with secretion. The first skin is a pale straw color, .4 mm. in length; second skin orange-yellow, .85 mm. long.

Female.—The body of the mature female is subcircular, usually from 1 to 1.5 mm. long, and .75 mm. wide; color brown. Presents the following characters:—

There are four groups of spinnerets. The anterior laterals vary from eleven to fourteen; the posterior laterals from seven to nine. There are three pairs of well developed lobes; the median pair commonly notched on the inner margin, sloping on the lateral margin, and very minutely serratulate; the second pair is smaller, and the third still smaller; the lateral margin of the second and third pair of lobes is sloping, and very minutely serratulate. The margin of the ventral aspect of the segment is deeply incised between the lobes. The parts of the body-wall forming the margin of these incisions are very much thickened. The plates are distinct, not longer than the lobes, fringed. There are two small ones between the median lobes; those of each side are as follows: two between the first and second lobes, three between second and third lobes, five or six laterad of the third lobe. The spines are prominent. The first, second, and third spines are situated near the lateral margin of the bases of the first, second, and third lobes; two more spines laterad of the base of the third lobe.

Scale of Male.—The scale of the male is circular, flat, and the same color as that of the female; about 1. mm. in diameter.

This species was found by the author on *Quercus* sp. Angio, Saitama-ken. The scale is extremely inconspicuous, as it lives beneath the epidermis on the under side of the leaf.

Type in the Entomological Collection of Leland Stanford Jr. University, and co-types in the author's collection.

46. Aspidiotus (Chrysomphalus) aurantii *Mask.*

Aspidiotus (Chrysomphalus) aurantii MASKELL, Trans. & Proc. New Zealand Inst., Vol. XI, 1878, p. 199. COCKERELL, Bull. No. 6, T. S., Div. Ent., U. S. Dept. Agric., 1897, p. 29.

This species was found by the author on a number of cultivated plants, namely: orange-tree and *Podocarpus chinensis*, in Wakayama-ken; on *Acacia* and the tea-plant in Yokohama; and on *Podocarpus chinensis* in Tokyo. Previous to this O. Takahashi, Tokyo, found it on *Podocarpus* in Japan.

47. **Aspidiotus (Chrysomphalus) ficus** *Ashm.*

Aspidiotus (Chrysomphalus) ficus RILEY & ASHMEAD, Amer. Ent., 1880, p. 267. CRAW, Rept. Calif. State Bd. Hort., 1895–96, p. 34. MASKELL, Proc. & Trans. New Zealand Inst., Vol. XXIX, 1896, p. 297; Ent. Mon. Mag., Vol. XXXIII, 1897, p. 241.

This species was found by the author on *Asparagus plumosus*, *Machilus thunbergii* (Inu-gusu), and Mango in Tokyo; on *Aspidistra lurida* and *Ligustrum japonicum* (Nezumi-mochi) in Yokohama. A. Craw, San Francisco, had previously recorded it on *Ilex latifolia* and *Aspidistra lurida* from Japan, and A. Koebele had also found it on *Quercus cuspidata* in Japan.

48. **Aspidiotus (Chrysomphalus) kelloggi,** sp. nov.

PLATE XII, FIGS. 72–74.

Scale of Female.—The scale of the female is circular, convex, with exuviæ on one side of the center; the portion of the first skin is indicated by a nipple-like prominence which is coal black; the part of the scale covering the second skin is black; the remainder of the scale is brown, varying from a reddish brown to almost black. The scale measures 2 mm. to 3 mm. in diameter. The ventral scale is distinct; dark brown.

Female.—The body of the mature female is globose, pale yellow, the last abdominal segment is yellow, and presents the following characters:—

There are four groups of spinnerets. Anterior laterals vary from 11 to 17; the posterior laterals from 12 to 14. The number varies on opposite sides of the same individual. There are three pairs of well developed lobes; they are subequal, the lateral sides are sloping and serratulate. Plates distinct, small, shorter than lobes, fringed. Between the first pair of lobes are two small plates; between the first and second lobes of each side are two, and between the second and third lobes are three similar plates; one plate laterad of the third lobe. The body-wall is furnished with six thickenings on each side of the meson. These thickenings are long, somewhat club-shaped, the anterior part being enlarged and rounded. There is one terminating the base of each margin of each lobe. Those ending at the base of the lateral margins of the first lobes, and between the second and third lobes, are much longer than the others. There are three spines, one at the middle of the base of each lobe, and two more beyond the third lobe.

Found by the author in Higuma-yama, Chikujo-gun, Kiushiu. The name of the host is unknown.

This species is allied to *Aspidiotus sphærioides* Ckll., but may be easily distinguished from that species by having only two pairs of spinnerets.

Genus **Leucaspis** *Sign.*

52. **Leucaspis japonica** *Ckll.*

Leucaspis japonica COCKERELL, Psyche, Vol. VIII, 1897, p. 53. CRAW, Rept. Calif. State Bd. Hort., 1897-98, p. 111.

This species was found by the author on apple-trees in Sendai, and Sapporo, on maple and *Pæonia moutan* (Botan) in Hirosaki, and on the same host in Yokohama. A. Craw, San Francisco, had already recorded it on broom, *Magnolia souleana*, and *Acer* sp. from Japan. It is extremely numerous in Sapporo, and no doubt is injurious to the fruit trees also.

53. **Leucaspis bambusæ,** sp. nov.

PLATE XIII, FIGS. 75-81.

Scale of Female.—Length usually 2 to 3 mm.; nearly parallel-sided, straight, though sometimes curved, gradually broadened posteriorly; convex, and moderately thick in texture; color snow-white; exuviæ about 1. mm. long; first skin light brown, elliptical; second, slightly darker.

Female.—Body very slender, narrower toward anterior end and broader toward posterior end. Abdominal segments distinct. The last segment is yellowish and presents the following characters:—

There are five groups of spinnerets. The anterior group contains five, the anterior laterals nine to eleven, and the posterior lateral seven to nine. There are two pairs of well developed and conspicuous lobes; those of the median pair parallel with each other, each one being furnished with a notch on each side; second pair flat, each lobe being divided into two nearly equal lobules, the larger of which is mesal, each lobule being furnished with a notch on each side. Plates shorter than the lobes, but very distinct, forked at the tip; two between median lobes, one between median and second lobes, three between second lobe and gland spine. Gland spines are prominent; formula, 1, 1, 2—3. First spine on the lateral margin of the median lobe, second spine at the middle of the margin of the second lobe, and third spine on the margin laterad of the second lobe.

Newly Hatched Larva.—Length .3 mm., width .11 mm.; elliptical; pale in color; distinctly segmented. Mouth-parts large; rostral loop long. Antennæ and legs well developed. Antennæ six-segmented; formula, 3, 6 (1, 2, 4, 3); segment 3 much the longest. Three pairs of legs subequal; femur very broad; tarsus short. Caudal end of body with two long hairs.

This species was found by the author on bamboo, in Kokura, Kiushiu.

Type in the Entomological Collection of Leland Stanford Jr. University, and co-types in the author's collection.

Genus **Hemichionaspis** *Ckll.*

54. **Hemichionaspis aspidistræ** *Sign.*

Hemichionaspis aspidistræ SIGNORET, Essai, 1869, p. 443.
Chionaspis aspidistræ CRAW, Rept. Calif. State Bd. Hort., 1895–96, p. 35.
COOLEY, Special Bull. Hatch. Exper. Station, Mass., 1899, p. 45. (The Coccidæ, Genera Chio. and Hemichio.)

This species was found by the author on *Aspidistra lurida* (Haran) and on an orchid in the Yokohama Nursery, Yokohama. A. Craw, San Francisco, had already recorded it on *A. lurida* from Japan.

55. **Hemichionaspis minor** *Mask.*

Hemichionaspis minor MASKELL, Trans. & Proc. New Zealand Inst., Vol. XVII, 1884, p. 33.

This species was found by the author on orange-trees in Kiushiu and Wakayamao-ken. The male scales are usually grouped on the under side of leaves or small twigs. This is the first time it has been recorded from Japan.

56. **Hemichionaspis minor** var. **strachani** *Cooley.*

Hemichionaspis minor var. *strachani* COOLEY, Special Bull. Hatch Exper. Station, Mass., 1899, p. 54.

This species was found by the author on *Cycas revoluta*, in the grounds of the Capitol of Hukuoka City. This is the first time it has been recorded from Japan.

Genus **Chionaspis** *Sign.*

57. **Chionaspis euonymi** *Comstock.*

Chionaspis euonymi COMSTOCK, Ent. Rept. U. S. Dept. Agric., 1880, p. 313.
CRAW, Rept. Calif. State Bd. Hort., 1895–96, p. 38.

This species was found by the author on *Euonymus japonica* (Masaki) in Sapporo and in Yokohama. A. Craw

San Francisco, had already recorded it on the same host from Japan.

58. Chionaspis bambusæ *Ckll.*

Chionaspis bambusæ COCKERELL, Psyche, Supp., 1896, p. 21; Bull. No. 4, T. S., Div. Ent., U. S. Dept. Agric., 1896, p. 54.

This species was found by the author on the leaves of bamboo, in Akabane. Previous to this O. Takahashi, Tokyo, sent specimens of the same to the Division of Entomology, U. S. Department of Agriculture, from which Professor Cockerell described the species.

59. Chionaspis (?) hikosani, sp. nov.

PLATE XIII, FIGS. 82 AND 83.

Scale of Female.—Very long and slender; length about 2.5 mm., width .4 mm.; sides straight, parallel, sometimes curved; color snow-white. First skin elliptical, almost transparent; median longitudinal ridge distinct; antennæ prominent; second skin very much longer, slightly convex, posterior end yellowish; exuviæ .75 mm. long.

Female.—Adult female very small; length less than 1 mm., width about .3 mm. Last abdominal segment presents the following characters:—

One pair of median lobes, short, diverging, and slightly notched on inner margin. One large gland-spine laterad of each median lobe. The plate-like margins are broad, rounded, and serrulate. Second pair of gland-spines rising from lateral side of the plate-like margin; the third pair of gland-spines is very conspicuous, being separated by a plate-like margin; first pair of spines on each side of median lobe near base; second pair of spines on plate-like margin near the lateral margin; third pair near the base of third pair of gland-spines. Spinnerets wanting.

This species was found by the author on *Phyllostachys bambusoides* (Ya-dake) at Hikosan, Kiushiu.

C. L. Marlatt, who has examined the specimens, says: "The structure of the female somewhat approaches genus *Leucaspis*, but the scale is entirely different from the *Leucaspis* type. To properly place it, one should have the male, which is wanting."

Type in the Entomological Collection of Leland Stanford Jr. University, and co-types in the author's collection.

60. Chionaspis platani *Cooley*.

Chionaspis platani COOLEY, Special Bull. Hatch Exper. Station, Mass., 1899, p. 36. (The Coccidæ, Genera Chio. and Hemichio.)

This species was found by the author on *Rhus* sp. in Aomori City. This is the first time it has been recorded from Japan.

61. Chionaspis wistariæ *Cooley*.

Chionaspis wistariæ COOLEY, Can. Ent., Vol. XXIX, 1897, p. 290; Special Bull. Hatch Exper. Station, Mass., 1899, p. 39. (The Coccidæ, Genera Chio. and Hemichio.) CRAW, Rept. Calif. State Bd. Hort., 1897–98, p. 110.

This species was found by the author on *Alnus japonica* (Hanno-ki) *Salix babylonica* (Shidare-yanagi), and *Salix* sp. in Gifu-ken. A. Craw has also recorded it on wistaria from Japan.

62. Chionaspis colemani, sp. nov.

PLATE XIII, FIG. 84.

Scale of Female.—Length about 2 to 2.5 mm., width about 1.5 mm. Decidedly broadened posteriorly; moderately strong in texture; color, pale straw-white. Exuviæ, 1 mm. long, first skin about .3 mm. long, elliptical, slightly broadened posteriorly; a median longitudinal ridge; antennæ prominent; color transparent. Second skin, large; slightly convex; posterior end orange-yellow.

Female.—Body of the female rather long and slender; length 1.2 to 2 mm.; width .5 to 1 mm.; elliptical in outline. The last abdominal segment presents the following characters: the lobes are very inconspicuous; the median lobes almost invisible, pointed; the second lobes are very small, being simply an angular projection of the body-wall; the third lobes are about twice as large as the second and project a little beyond the margin of the segment The second and third lobes are more or less ciliated. Many suboval, thickened bodies in near the margin are very conspicuous as shown in the figure. The gland-spines are arranged as follows: 1, 1, 2, 1, 1, 1; they are similar except that the last one is forked; one between first and second lobes, one between second and third lobes, two laterad of third lobes and three more beyond that. Spines are prominent, extending beyond plates. The first pair are situated near the lateral margin of the first lobes; the second about the lateral margin of the base of the outer lobules of the second lobes; the third pair on the lateral margin of the third lobes; another pair of spines outside of the third lobes. There are five groups of spinnerets; the anterior group contains seven to ten; the anterior laterals, twelve to sixteen; the posterior laterals, nine to fifteen.

Scale of Male.—Length about .8 mm.; slender, convex; color grayish white.

Egg.—Length about 2 mm.; oval; pale in color.

Found by the author on bamboo, Hikosan, in Kiushiu, and named in honor of Mr. G. A. Coleman of Stanford University.

This new species is allied to *C. bambusæ* Ckll., but is distinguished from it by having a rather short and very broad female scale, with many ridges on the dorsal aspect, as in a certain mollusca. There is also a difference in the arrangement of the gland-spines and in the shape of the plates.

Prof. R. A. Cooley of Montana Agricultural Station, who kindly examined my specimens, writes as follows:—

> "The specimens you sent me were rather troublesome. I made several attempts at determining them and even went so far as to write you a letter which I later withheld. I have again reviewed the matter to-day [Nov. 6, 1901] and after an extended comparison feel sure that your species is a new one.
>
> "It is near *C. bambusæ* Ckll., and is also near *C. doxyli* Mask.
>
> "While we cannot do better than to place it in the genus *Chionaspis* at present, it is certain that it does not belong to *Chionaspis* proper."

Type in the Entomological Collection of Leland Stanford Jr. University, and co-types in the author's collection.

Genus **Parlatoria** *Sign.*

63. **Parlatoria pergande** *Comstock.*

Parlatoria pergande COMSTOCK, Ent. Rept. U. S. Dept. Agric., 1880, p. 327. CRAW, Rept. Calif. State Bd. Hort., 1897–98, p. 98.

This species was found by the author on orange-trees, in Kokura. A. Craw, San Francisco, has also recorded it on the same host from Japan.

64. **Parlatoria pergande,** var. **theæ** *Ckll.*

Parlatoria pergande var. *theæ* COCKERELL, Bull. No. 4, T. S., Div. Ent., U. S. Dept. Agric., 1896, p. 55; Psyche, Supp., 1896, p. 21.

This species was found by the author on *Acer cratægifolium* (Uri-kaede) in Kyoto, on *Acer pictum* var. *mono*

(Itaya-kaede) in Osaka, on *Diospyros kaki* in Chikujo-gun, Kiushiu, on rose in Gifu-ken, on apple in Tokyo, on *Cornus macrophylla* (Mizuki) and *Osmanthus fragrans* (Mokusei) in the Yokohama Nursery, Yokohama, and on *Hibiscus syriacus* (Mukuge) in Sendai.

This scale is widely distributed and is very destructive to the ornamental trees and plants.

65. **Parlatoria proteus** *Curt.*

Parlatoria proteus CURT. SIGNORET, Essai, 1867, p. 450. CRAW, Rept. Calif. State Bd. Hort., 1897–98, p. 112. MASKELL, Ent. Mon. Mag., Vol. XXXIII, 1897, p. 241.

This species was found by the author on *Angræcum falcatum* (Furan) in Yokohama. A. Craw, San Francisco, has recorded it on orange-tree, and A. Koebele on camellia and *Machilus* from Japan.

Genus **Fiorinia** *Targ.*

66. **Fiorinia fioriniæ** (?) *Targ.-Tozz.*

Fiorinia fioriniæ (?) TARGET-TOZZINI. SIGNORET, Essai, 1896, p. 449.

This species was found by the author on fern in the Yokohama Nursery, Yokohama. A. Craw, San Francisco, has also recorded it on camellia from Japan.

67. **Fiorinia fioriniæ** *Targ.-Tozz.* **japonica**, var. nov.

This variety differs from the typical *F. fioriniæ* by having numerous spinnerets, particularly in the lateral groups:—

Anterior group, 3 to 4; anterior lateral groups, 16 to 22; posterior lateral groups, 24 to 27. The other characters are identical.

Found by the author on *Podocarpus chinensis* (Maki) in the grounds of the Nishigahara Experiment Station, Tokyo, and Gifu-ken, and on *Pinus* sp. in Shiga-ken.

Genus **Mytilaspis** *Sign.*

68. **Mytilaspis pomorum** *Bouché.*

Mytilaspis pomorum BOUCHÉ. COMSTOCK, Ent. Rept. U. S. Dept. Agric., 1880, p. 325.

This species was found by the author on apple, *Mespilus, cuneata*, and currant in Sapporo, on willow in Aomori, on apple in Sendai and Morioko, on orchid in Yokohama, and on *Ilex crenata* (Inu-tsuge) in Hikosan. There is considerable variation in color, those on *Mespilus cuneata* (Sanzashi) being light brown, those on currant dark brown, and those on apple grayish. This insect though not recorded has been known in Japan for some time.

69. **Mytilaspis pomorum** *Bouché* **japonica**, var. nov.

Scale of Female.—Dark with yellowish brown exuviæ.

Female.—Yellowish in color; posterior region of the body very much wider than the thoracic region. Anterior group of spinnerets consists of four to eight, anterior laterals, eleven to sixteen, and posterior laterals, seven to twelve. The lobes are of the same shape as those of the typical *M. pomorum* but much smaller. The notches on the lobes are not quite so distinct as in the type.

This species was found by the author on *Abies firma* (Inu-kaya) in Hikosan, Kiushiu.

70. **Mytilaspis euryæ,** sp. nov.

PLATE XIII, FIGS. 85-89.

Scale of Female.—Length 3-4 mm.; long, narrow, widened posteriorly, straight, sometimes curved; color dark brown. First skin pale brown, showing segmentation distinctly, second skin more or less covered by the secretion.

Female.—Length 1.35 mm., width .6 mm.; color pale brown, posterior region yellow. The last abdominal segment presents the following characters:—

There are five groups of spinnerets. The anterior group consists of four to five, anterior lateral, seven to nine, and posterior lateral, seven to eight. Lobes small; median lobes rounded, usually notched on the lateral margin near tip; second pair flat, each lobe being divided into nearly equal lobules, the larger of which is mesad. Plates simple, spiny and tapering; two between meso and second lobes, three outside of the second lobes. Spines inconspicuous; the first pair situated near the lateral margin of the base of the first lobes; the second, about the middle of the base of the second lobes; the third, laterad of the base of the third lobes.

This species was found by the author on *Eurya ochnacea* in Hikosan, Kiushiu.

Type in the Entomological Collection of Leland Stanford Jr. University, and co-types in the author's collection.

71. Mytilaspis gloverii *Pack.*

Mytilaspis gloverii PACKARD. COMSTOCK, Ent. Rept. U. S. Dept. Agric., 1880, p. 323.

This species was found by the author on orange in Gifuken and orange leaves and twigs in Kiushiu and Wakayama-ken. The scales on the twigs were very much darker than those on the orange. This is the first time it has been recorded from Japan.

72. Mytilaspis citricola *Pack.*

Mytilaspis citricola PACKARD. MASKELL, Ent. Mon. Mag., Vol. XXXIII, 1897, p. 241.

This species was found by the author on orange-tree in Chikujo-gun, Kiushiu, and on *Cercidiphyllum japonicum* (Katsura) in Hirosaki. A. Koebele has also recorded it on *Taxus cuspidata* (Ichii) in Japan.

73. Mytilaspis newsteadi *Sulc.*

Mytilaspis newsteadi SULC, S. B. bohm. Gesell., 1895, No. XLIX, pp. 8 and 19.

This species was found by the author on the leaves of *Thea japonica*, Tokyo. This is the first time it has been recorded from Japan.

74. Mytilaspis newsteadi *Sulc.* tokionis, var. nov.

This variety differs from the typical *M. newsteadi*, first, in being larger and more slender; second, in having the median lobes more or less diverged and each side abruptly narrowed, then prolonged more or less into a point, with the margins slightly serratulate.

The male scale is narrower than the typical *M. newsteadi.*

This species was found by the author on *Codiæum* sp. in a green-house in Tokyo. It is a very destructive pest, particularly to the above named plant.

75. **Mytilaspis crawii** *Ckll.*

Mytilaspis crawii COCKERELL, Psyche, Supp., 1896, p. 21; Bull., T. S., No. 4, Div. Ent., U. S. Dept. Agric., 1896, p. 45. CRAW, Rept. Calif. State Bd. Hort., 1895-96, p. 41. MASKELL, Ent. Mon. Mag., Vol. XXX, 1897, p. 241.

This species was found by the author on *Quercus* (Pasania) *cuspidata* (Shii) in Tokyo. Previous to this, A. Craw, San Francisco, had recorded it on the same host and on *Elæagnus* from Japan.

Genus **Poliaspis** *Mask.*

76. **Poliaspis pini** *Mask.*

Poliaspis pini MASKELL, Trans. & Proc. New Zealand Inst., Vol. XXX, 1897, p. 231; Ent. Mon. Mag., Vol. XXXIII, 1897, p. 242.

This species is widely distributed, being found nearly all over the Empire. The author found it on the following plants: *Pinus austriaca*, *Pinus* sp., *Pinus thunbergii*, *Torreya nucifera*, *Abies firma*, and *Picea bicolor*, in the grounds of the Nishigahara Agricultural Experiment Station, Tokyo; on *Pinus* sp., Kubotesan, Kiushiu; on *Pinus* sp. in Shigaken, and on *Podocarpus chinensis* in Wakayama-ken. A. Koebele has recorded it on *Pinus densiflora*, Miyanoshita, Japan.

The specimens collected in Wakayama-ken, on *Podocarpus chinensis*, are slightly different from the others, although the differences are not sufficient to make a new species or variety. The female scale is light brown, narrower than the others. The spinnerets are fewer in number, particularly those of the posterior lateral groups, and of the middle one of the anterior row of three groups.

III. LIST OF COCCIDÆ RECORDED FROM JAPAN NOT INCLUDED IN THE FOREGOING LIST.

Dactylopius syringæ MASK., Trans. & Proc. New Zealand Inst., Vol. XXX, 1897, p. 246.

Dactylopius edgeworthiæ CKLL., Am. Nat., Vol. XXX, 1897, p. 589.

Dactylopius virgatus CKLL. (=*D. ceriferus* NEWST., Ind. Mus. Notes, Vol. III, 1894, p. 24); Can. Ent., Vol. XXX, 1898, p. 222; Trans. & Proc. New Zealand Inst., Vol. XXIX, 1896, p. 320.

Phenacoccus pergandei CKLL., Psyche, Supp., 1896, p. 17; Bull. No. 4, T. S., Div. Ent., U. S. Dept. Agric., 1896, p. 55.

Sphærococcus populi MASK., Ent. Mon. Mag., Vol. XXXIII, 1897, p. 244; Trans. & Proc. New Zealand Inst., Vol. XXX, 1897, p. 248.

Asterolecanium (Planchonia) delicata GREEN, Ent. Mon. Mag., Vol. XXXIII, 1897, p. 243.

Asterolecanium variolosum var. *japonicum* CKLL., Psyche, Vol. IX, 1900, p. 71.

Lecanium notatum MASK., Ent. Mon. Mag., Vol. XXXIII, 1897, p. 243; Trans. & Proc. New Zealand Inst., Vol. XXX, 1897, p. 238.

Lecanium cerasarum CKLL., Psyche, Vol. IX, 1900, p. 71.

Ceronema japonicum MASK., Ent. Mon. Mag., Vol. XXXIII, 1897, p. 243.

Aspidiotus secretus CKLL., Psyche, Supp., 1896, p. 20; Bull. No. 4, T. S., Div. Ent., U. S. Dept. Agric., 1896, p. 51.

Aspidiotus greenii CKLL. (=*A. lataniæ*), Ent. Mon. Mag., Vol. XXXIV, 1898, p. 184; Bull. No. 6, T. S., Div. Ent., U. S. Dept. Agric., 1897, p. 27; Rept. Calif. State Bd. Hort., 1897–98, p. 102.

Aspidiotus perniciosus var. *andromelas* CKLL., Bull. No. 6, T. S., Div. Ent., U. S. Dept. Agric. 1897, p. 20; Rept. Calif. State Bd. Hort., 1897–98, p. 107.

Aspidiotus perniciosus var. *albopunctatus* CKLL., Bull. No. 4, T. S., Div. Ent., U. S. Dept. Agric., 1896, p. 43; Psyche, Supp., 1896, p. 20; Rept. Calif. State Bd. Hort., 1895–96, p. 33.

Aspidiotus cryptoxanthus CKLL., Psyche, Vol. IX, 1900, p. 71.

Aspidiotus setiger MASK., Trans. & Proc. New Zealand Inst., Vol. XXIX, 1896, p. 298.

Aspidiotus bambusarum CKLL., Psyche, Vol. VIII, 1897, p. 191; Rept. Calif. State Bd. Hort., 1897–98, p. 108.

Aspidiotus aurantii var. *citrinus* COQU., Bull. No. 4, T. S., Div. Ent., U. S. Dept. Agric., 1896, p. 40.

Aulacaspis rosæ var. *spinosa* MASK., Ent. Mon. Mag., Vol. XXXIII, 1897, p. 241; Trans. & Proc. New Zealand Inst., Vol. XXX, 1897, p. 228.

Diaspis auranticolor CKLL., Can. Ent., Vol. XXXI, 1899, p. 107.

Aonidia elæagnus MASK., Ent. Mon. Mag., Vol. XXXIII, 1897, p. 241; Trans. & Proc. New Zealand Inst., Vol. XXX, 1897, p. 227.

Chionaspis chinensis CKLL., Ent. Mon. Mag., Vol. XXXIII, 1897, p. 242; Trans. & Proc. New Zealand Inst., Vol. XXX, 1897, p. 231; Rept. Calif. State Bd. Hort., 1895–96, p. 37.

Chionaspis eugeniæ MASK., Trans. & Proc. New Zealand Inst., Vol. XXIX, 1896, p. 306.

Chionaspis latus CKLL. (=var. of *C. aspidistræ*), Bull. No. 4, T. S., Div. Ent., U. S. Dept. Agric., 1896, p. 53; Psyche, Supp., 1896, p. 21.

Chionaspis aucubæ COOLEY, Can. Ent., Vol. XXIX, 1897, p. 279.

Chionaspis difficilis CKLL., Bull. No. 4, T. S., Div. Ent., U. S. Dept. Agric., 1896, p. 42; Psyche, Supp., 1896, p. 21; Rept. Calif. State Bd. Hort., 1895-96, p. 38.

Chionaspis vitis GREEN, Indian Mus. Notes, Vol. IV, p. 3.

Chionaspis graminis GREEN, Indian Mus. Notes, Vol. IV, p. 3; Ent. Mon. Mag., Vol. XXXIII, 1897, p. 242.

Chionaspis latissima CKLL., Can. Ent., Vol. XXIX, 1897, p. 282; Rept. Calif. State Bd. Hort., 1897-98, p. 110; Calif. Fruit Grower, June 5, 1897, pp. 4 & 5.

Chionaspis citri COMST., Rept. Calif. State Bd. Hort., 1895-96, p. 38.

Parlatoria proteus var. *virescens* MASK., Ent. Mon. Mag., Vol. XXXIII, 1897, p. 241; Trans. & Proc. New Zealand Inst., Vol. XXIX, 1896, p. 300.

Parlatoria theæ var. *euonymi* CKLL., Am. Nat., Vol. XXXI, 1897, p. 591; Rept. Calif. State Bd. Hort., 1897-98, p. 112.

Parlatoria theæ var. *viridis* CKLL., Bull. No. 4, T. S., Div. Ent., U. S. Dept. Agric., 1896, p. 43; Psyche, Supp., 1896, p. 21; Rept. Calif. State Bd. Hort., 1895-96, p. 42.

Fiorinia signata MASK., Ent. Mon. Mag., Vol. XXXIII, 1897, p. 242; Trans. & Proc. New Zealand Inst., Vol. XXX, 1897, p. 231.

Fiorinia tenuis MASK., Ent. Mon. Mag., Vol. XXXIII, 1897, p. 242; Trans. & Proc. New Zealand Inst., Vol. XXX, 1897, p. 232.

Ischnaspis filiformis DOUGL. (=*I. longirostris* SIGN.), Ent. Mon. Mag., Vol. XXIV, 1897, p. 242; Rept. Calif. State Bd. Hort., 1895-96, p. 40; Ent. Mon. Mag., Vol. XXXIII, p. 21.

Mytilaspis machili MASK., Trans. & Proc. New Zealand Inst., Vol. XXX, 1897, p. 230.

Mytilaspis crawii var. *canaliculata* MASK., Trans. & Proc. New Zealand Inst., Vol. XXIX, 1896, p. 304; Ent. Mon. Mag., Vol. XXXIII, 1897, p. 241.

Mytilaspis pallida GREEN, Ent. Mon. Mag., Vol. XXXIII, 1897, p. 241.

Mytilaspis pallida var. *maskelli* CKLL., Rept. Calif. State Bd. Hort., 1897-98, p. 112.

STANFORD UNIVERSITY,
CALIFORNIA,
September, 1901.

EXPLANATION OF PLATE VII.

Monophlebus corpulentus, sp. nov.

Fig. 1. Dorsal aspect of female.
Fig. 2. Antenna of female.
Fig. 3. Leg of female; 3*a*, claw.

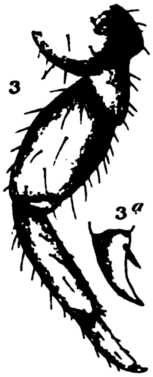
Sasakia quercus, sp. nov.

Fig. 4. Ventral aspect of female.
Fig. 5. Antenna of female.
Fig. 6. Leg of female.
Fig. 7. Posterior segment of larva.
Fig. 8. Antenna of larva.

Kermes nakagawæ, sp. nov.

Fig. 9. Scales on a twig.
Fig. 10. Antenna of female.
Fig. 11. Leg of female.
Fig. 12. First larval stage (ventral aspect).
Fig. 13. Antenna of the same.
Fig. 14. Leg of the same; 14*a*, claw.
Fig. 15. Posterior margin of the same.

3



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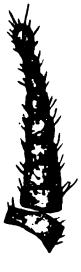

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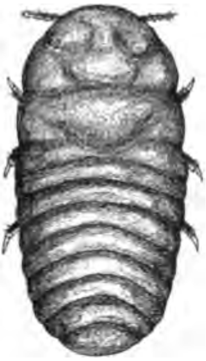

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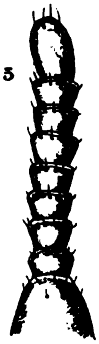

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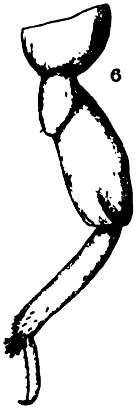

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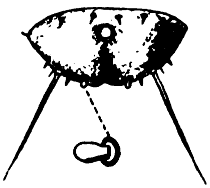

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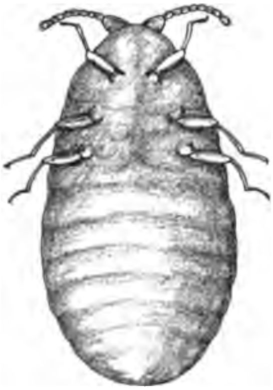

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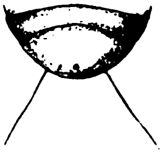

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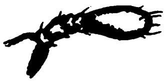

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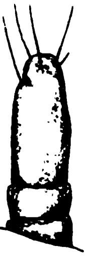

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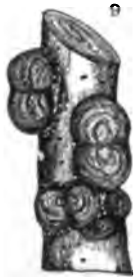

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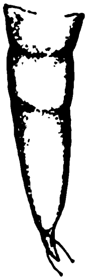

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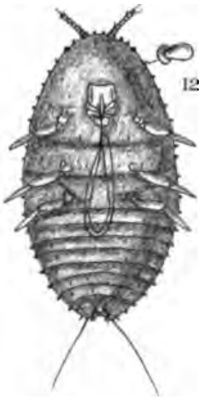

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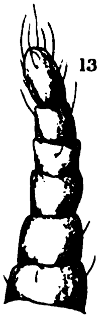

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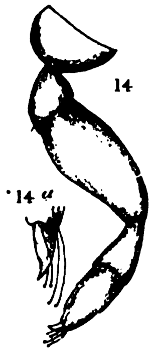

KUWANA DEL.

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EXPLANATION OF PLATE VIII.

Kermes nawæ, sp. nov.

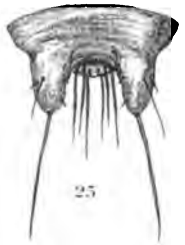
Fig. 16. Scale on a twig.
Fig. 17. Antenna of female.
Fig. 18. Leg of female.
Fig. 19. Ventral aspect of first larval stage.
Fig. 20. Antenna of first larval stage.
Fig. 21. Leg of first larval stage; *21a*, claw.
Fig. 22. Posterior end of first larval stage.

Eriococcus japonicus, sp. nov.

Fig. 23. Female sacs and male cocoons on a twig.
Fig. 24. Antenna of female.
Fig. 25. Posterior end of female.

Eriococcus onukii, sp. nov.

Fig. 26. Female scale on a twig.
Fig. 27. Dorsal aspect of female.
Fig. 28. Ventral aspect of female.



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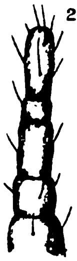

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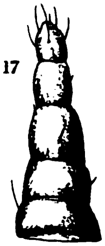

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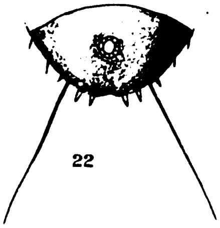

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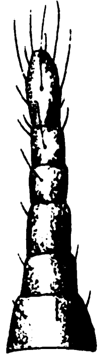

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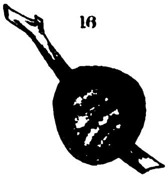

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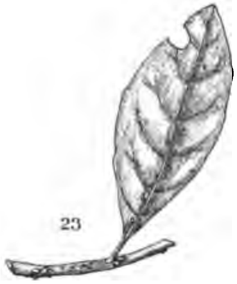

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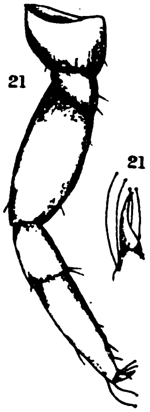
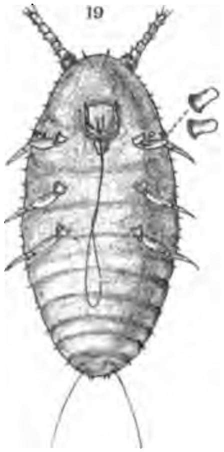


21

21 *a*



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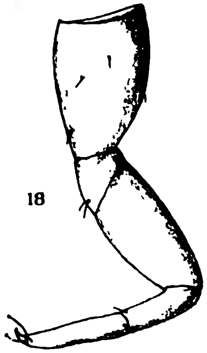

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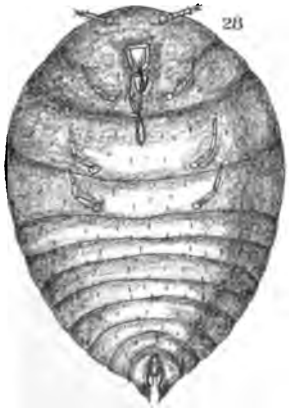

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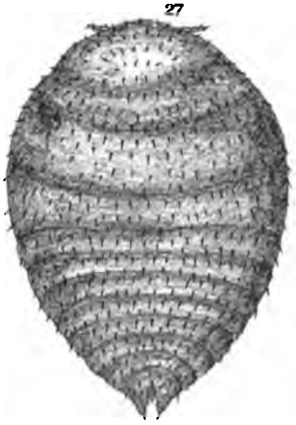

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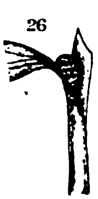

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EXPLANATION OF PLATE IX.

Eriococcus onukii, sp. nov.

Fig. 29. Antenna of female.
Fig. 30. Leg of female.
Fig. 31. Dorsal spines of female.
Fig. 32. Antenna of first larval stage.
Fig. 33. Leg of first larval stage.

Dactylopius comstocki, sp. nov.

Fig. 34. Antenna of female.
Fig. 35. Leg of female.

Dactylopius pini, sp. nov.

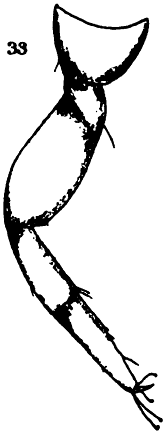
Fig. 36. Antenna of female.
Fig. 37. Leg of female; 37*a*, claw.
Fig. 38. Antenna of first larval stage.

Dactylopius kraunhiæ, sp. nov.

Fig. 39. Antenna of female.
Fig. 40. Leg of female; 40*a*, claw.

Sphærococcus parvus Mask.

Fig. 41. Antenna of first larval stage.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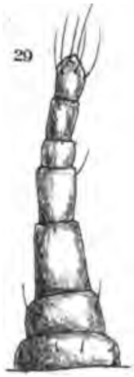
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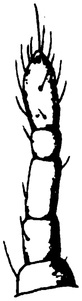
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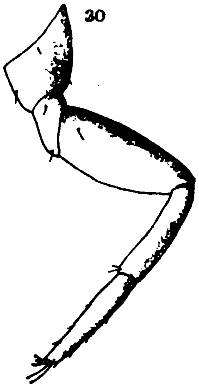
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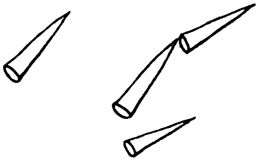
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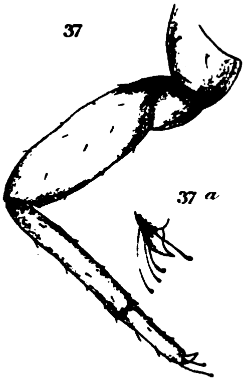
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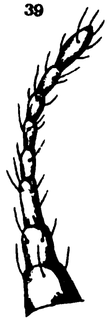
37 a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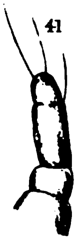
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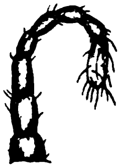
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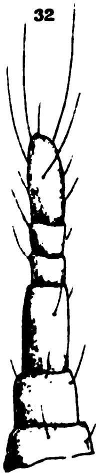
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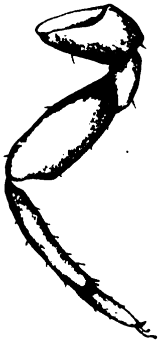
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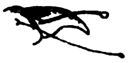
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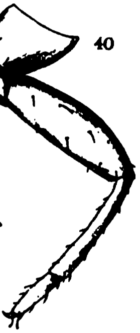
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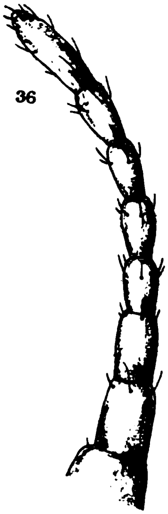
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EXPLANATION OF PLATE X.

Pulvinaria psidii Mask.

Fig. 42. Marginal spines of female.

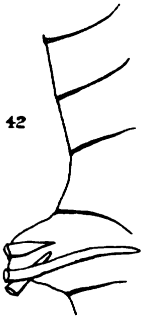
Pulvinaria aurantii Ckll.

Fig. 43. Marginal spines of female.

Pulvinaria horii, sp. nov.

Fig. 44. Female scales on a host.
Fig. 45. Marginal spines of female.
Fig. 46. Antenna of female.
Fig. 47. Leg of female.
Fig. 48. Ventral aspect of first larval stage.
Fig. 49. Antenna of first larval stage.
Fig. 50. Leg of first larval stage.
Fig. 51. Marginal spines of first larval stage.
Fig. 52. Anal triangular plates of first larval stage.

42



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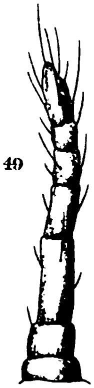

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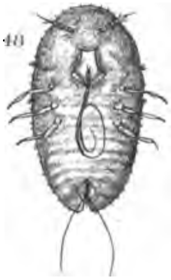

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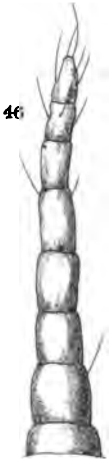

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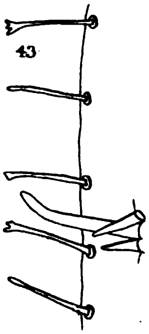

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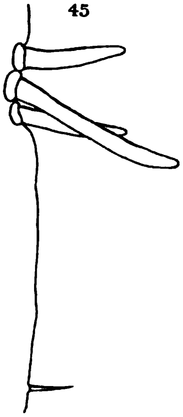

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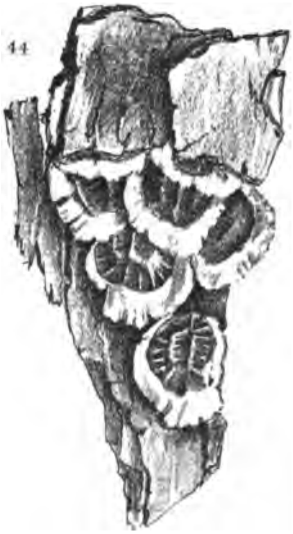

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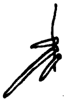

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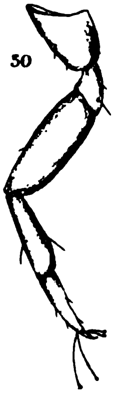

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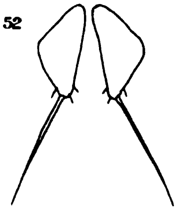

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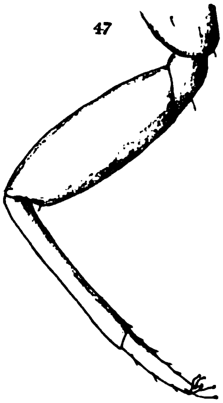

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EXPLANATION OF PLATE XI.

Pulvinaria oyamæ, sp. nov.

Fig. 53. Female on twig.
Fig. 54. Antenna of female.
Fig. 55. Leg of female; 55*a*, claw.
Fig. 56. Marginal spines of female.

Pulvinaria hazeæ.

Fig. 57. Antenna of female.
Fig. 58. Leg of female; 58*a*, claw.
Fig. 59. Marginal spines of female.

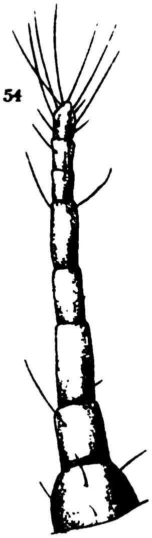
Lecanium takachihoi, sp. nov.

Fig. 60. Female on a twig.
Fig. 61. Antenna of female.
Fig. 62. Leg of female; 62*a*, claw.
Fig. 63. Antenna of first larval stage
Fig. 64. Leg of first larval stage.

Lecanium, sp.

Fig. 65. Female on a twig.

54



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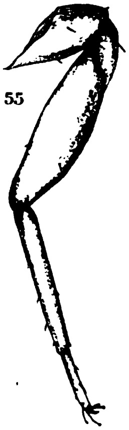

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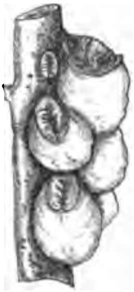

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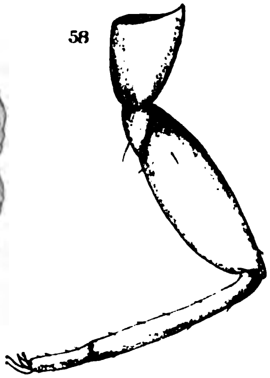

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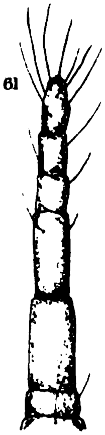
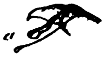
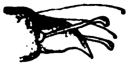


55 *a*



58 *a*



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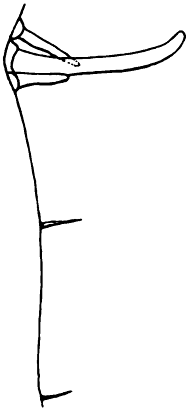

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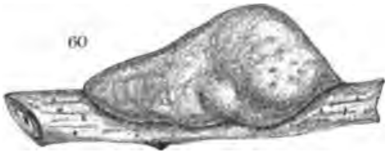

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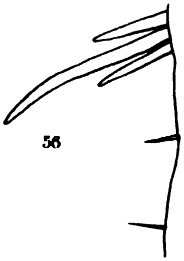

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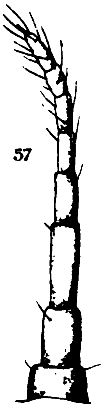

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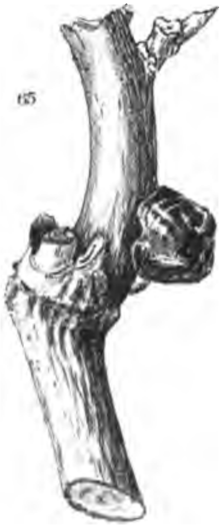

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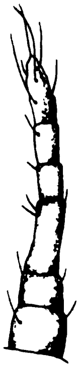

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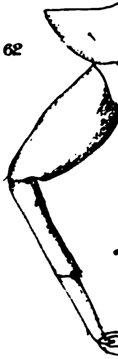
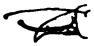


62 *a*



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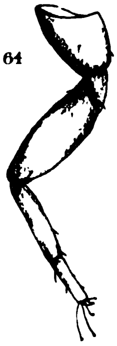

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EXPLANATION OF PLATE XII.

Aspidiotus cryptomeriæ, sp. nov.

Fig. 66. Female scale; 66*a*, male scale.
Fig. 67. Female.
Fig. 68. Last abdominal segment of female.

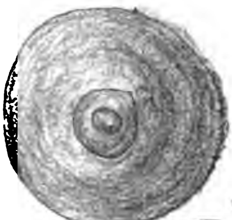
Aspidiotus jordani, sp. nov.

Fig. 69. Female scale; 69*a*, male scale.
Fig. 70. Female.
Fig. 71. Last abdominal segment of female.

Aspidiotus kelloggi, sp. nov.

Fig. 72. Female scale; 72*a*, male scale.
Fig. 73. Female; 73*a*, antenna.
Fig. 74. Last abdominal segment of female.

69



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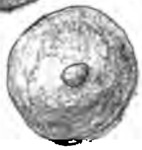

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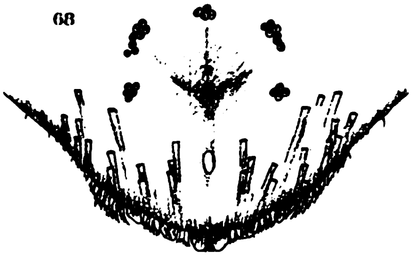

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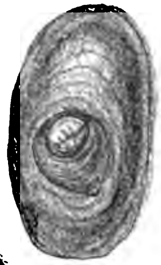

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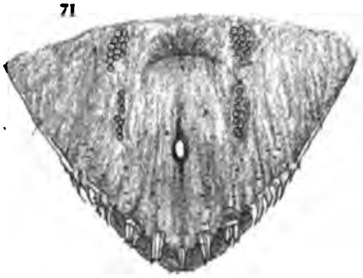

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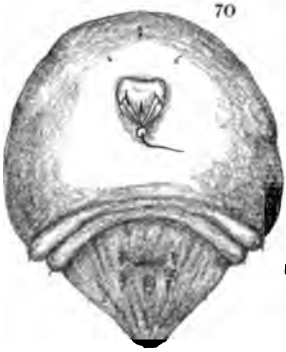

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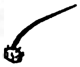

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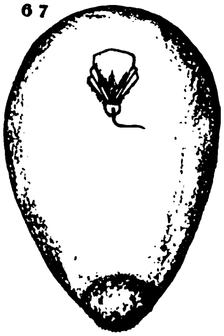

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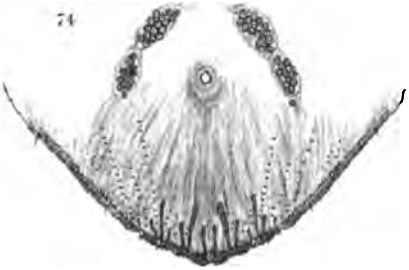

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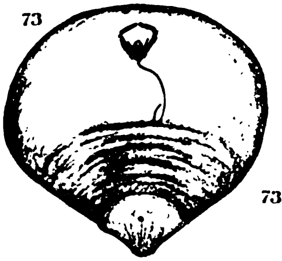

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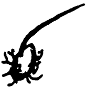

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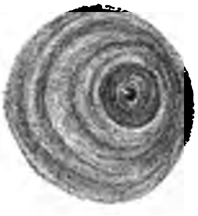

72 a

KUWANA DEL.

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EXPLANATION OF PLATE XIII.

Leucaspis bambusæ, sp. nov.

Fig. 75. Scales on a twig.
Fig. 76. Ventral aspect of female scale.
Fig. 77. Dorsal aspect of female scale.
Fig. 78. Female.
Fig. 79. Last abdominal segment of female.
Fig. 80. Antenna of first larval stage.
Fig. 81. Leg of first larval stage.

Chionaspis hikosani, sp. nov.

Fig. 82. Female scales.
Fig. 83. Last abdominal segment of female.

Chionaspis colemani, sp. nov.

Fig. 84. Last abdominal segment of female.

Mytilaspis euryæ, sp. nov.

Fig. 85. Scales on a leaf.
Fig. 86. Female scale.
Fig. 87. Female scale.
Fig. 88. Female.
Fig. 89. Last abdominal segment of female.

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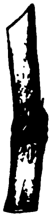

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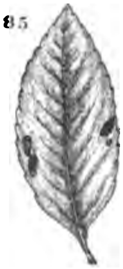

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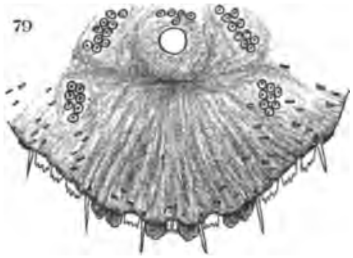

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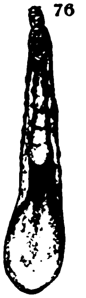

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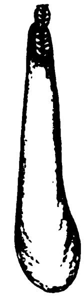

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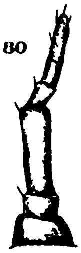

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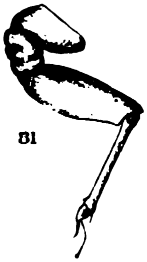

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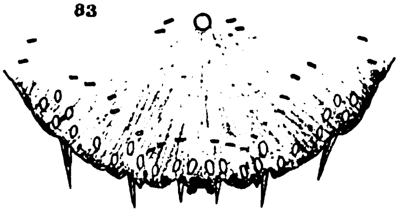

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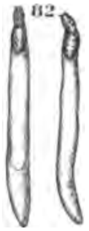

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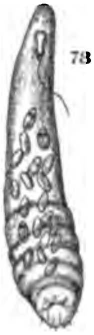

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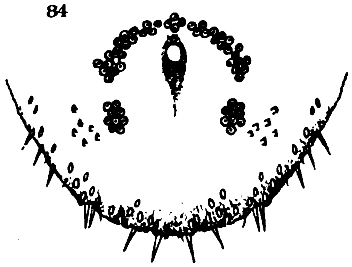

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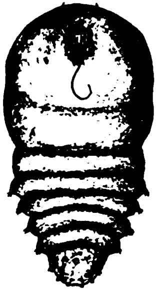

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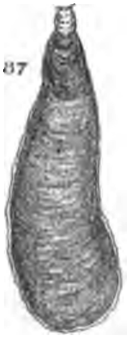

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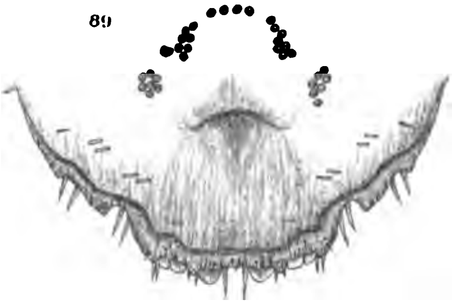

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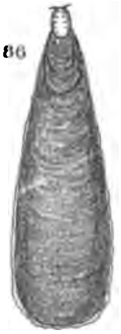

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